DISASTER-FRIENDLY LOW-COST HOUSE-BUILDING MANUAL

DWELLING IN RIVER BANK EROSION VULNERABLE AREA

CARITAS BANGLADESH
House # 02, Outer Circular Road
Shantibagh, Dhaka 1217
BANGLADESH

Disaster-friendly Low-cost House-building Manual

Relevant to River Bank Erosion Vulnerable Area

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PREFACE

Caritas Bangladesh commenced its disaster management program and initiated relevant activities to serve the disaster-affected community in the background of cataclysmic November 12, 1970 Cyclone and Storm Surge in the southern part of the country as well as to respond to dire needs of millions affected by nine-month long 1971 Bangladesh War of Liberation.

Bangladesh is one of world's most disaster-vulnerable areas on account of its geographic location. Natural hazards like flood, flash flood, cyclone, storm surge, drought, river-bank erosion, landslide, etc., cause immense human casualty, crop failure and property loss almost every year, affecting the poor and low-income people. General public are very much affected and distressed on account of house collapse leading to troublesome accommodation problem in the wake of such disaster occurrence. Poverty and poor earning prevent average people from building and owning strong and well-built house, and this hard fact results in damage and destruction of their dwelling options following moderate wind and/or water in-flow.

Caritas Bangladesh identified this housing problem as far back as 1985 and has been on the move since then to find a practicable way out. It adopted a "Low-cost Housing" pilot project in 2010 following the 'evaluation of low-cost housing assistance' project undertaken earlier in 2007 to serve the families distressed by November 15, 2007 Cyclone SIDR. Low-cost houses were constructed during 2010 in cyclone-prone Kalapara upazila (sub-district) under Patuakhali district and flood-prone Sirajdi Khan upazila (sub-district) under Munshiganj district to provide relief to disaster affected families.

Eventually in 2012-14 following adequate experiment, study and observation, a pilot project titled Low Cost Housing (Pilot LCH) was taken in hand under financial assistance from Secours Catholique–Caritas France and Caritas Luxemburg. Prime aim and objective of the Project was evolving viable design and strategy towards construction of low-cost sustainable and disaster-friendly house according to hazard types in disaster-vulnerable areas of Bangladesh as well as to encourage and motivate the poor community at risk to accept and pursue them; Caritas utilized technical assistance in this respect from Bangladesh University of Engineering and Technology (BUET) and CRAterre France.

Mainstreaming Disaster Friendly Low Cost Housing (MDFLCH) project was subsequently undertaken for the period of 2016-18 under financial assistance from Secours Catholique – Caritas France. As part of the project, Caritas developed as many as 35 structural designs compatible to disaster-friendly and sustainable house construction in view of hazard types and hazard-risky area; BUET and CRAterre France provided necessary technical assistance in the exercise. To promote the issue further, 105 disaster-friendly and sustainable low-cost model houses were constructed according to these designs in 20 unions of 20 upazilas under 17 districts within 08 dioceses of Caritas Bangladesh.

Later, Disaster Management Committee members at union and ward level and Asrayon Task Force members within MDFLCH project area, project staff and BUET teachers visited the model houses time to time; they utilized these fact-finding visits to reflect on such relevant aspects as various designs, building pattern, local culture, easy availability of building materials in the locality, cost, etc.

Pertinent house-building aspects in consideration of threats and risks associated with flood, flash flood, cyclone and storm surge, river-bank erosion and drought vulnerable areas of Bangladesh were well discussed and duly analyzed at field, regional and national level to develop 'low-cost and sustainable house-building Instruction Manual' involving 10 construction steps. Workshops were organized at regional and national level in order to fine tune the issue and finalize 05 (five) low-cost house-building Guide Books to serve the purpose of the dwellers living in fore-noted five hazard-vulnerable areas.

Bangladesh is a riverine country, its entire land area being crisscrossed by more than 250 large, moderate and small rivers. The country experiences substantial rain every year due to active monsoon during June to August. Heavy rain-fall exceeds the capacity of the rivers to contain water and thereby triggers flood. About 2,400 km land area is yearly devoured in the rivers, apart from occurrence of flood. River-bank erosion is very common along the banks of three large rivers of Bangladesh, viz., Padma, Jamuna and Meghna. Homesteads, landed property, market places, all these are devastated by river-bank erosion. River-bank erosion compels people to relocate their living place; they have to shift away to other places along with their homestead, etc., as soon as the erosion process nears their home and hearth. Displacement of thousands families in the country along the river side is a regular occurrence due to river-bank erosion during monsoon. This Low-cost House Construction Manual offers the design and strategy of a house that can be suitably relocated in good order in the face of river-bank erosion.

Disaster Management Sector of Caritas Bangladesh in cooperation with its eight Regional Offices had to put in extensive work and diligent effort to develop this Instruction Manual. Secours Catholique–Caritas France and Caritas Luxemburg provided financial assistance and Bangladesh University of Engineering and Technology (BUET) and CRAterre France offered technical assistance. We are sincerely grateful to all of them. We are equally grateful to International Federation of Red Cross and Red Crescent Societies (IFRCS) to allow us to utilize 16 (sixteen) of their suitable pictures for the Manual: (Cf. Session-1 Pics.5 & 12; Session-2 Pics.15 & 21; Session-4 Pic.58; Session-8 Pics.81, 82, 83, 84, 85, 86, 87, 88, 89; Session-9 Pics.90 & 91).

The Manual refers to the building materials compatible to hazard-risk reducing construction and narrates the requisite strategy. We are convinced that proper training of the construction labour force as per the Manual, involvement of the people to its purpose and construction of hard and strong house in the disaster prone area in accordance with its guidelines will make for minimal damage and loss in disaster aftermath. We also firmly believe that this Manual will capacitate the poor community living in the river-bank erosion risk vulnerable zones alongside the rivers of Bangladesh to build low-cost, erosion absorbing, sustainable as well as safe and comfortable house.

To conclude, changing and advanced technology and variation in hazard pattern will necessitate modification and re-edition of the Manual in view of time-to-time reflection and observation, and we will do the needful accordingly. Valuable advice and opinion of the Readers and Users of the Guide Book will be attached due importance during re-editing process.

Feancis Atul Sarker
Executive Director
Caritas Bangladesh

Session I

Subject: House Layout
(First Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To explain formation of the Layout of a disaster-resilient house and succeed in forming a layout. 2. To pin-point the area, type and set-up of the Layout as well as mention the advantages and disadvantages thereof. 3. To describe the disaster risk reduction aspects/isues while formulating the Layout and apprise others accordingly.
Time	75 Minutes
Methodology	Lecture, Discussion, Event recounting, Question-Answer, Experience sharing, Picture display and Drawing.
Materials	Board, Poster Paper, Marker, Flip Chart, Scale, Tape, Rope, Thread, Bamboo Pillar, Hammer, Spade, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will seek participants' view/opinion about layout, rationale behind layout, nature of layout in their locality, which points / issues are considered relevant to site selection during construction of a house. 2. Following participants response, s/he will expose them to issues for consideration in respect of house site selection through relevant picture(s) by way of flipchart/multi-media; s/he will also provide handout/sample picture(s) to them.
	Step-III:Time-25 Minutes Facilitator will take the participants in the field and impart practical lesson on layout setting..
	Step-IV:Time-10 Minutes Facilitator will point out to the participants what disaster risk reduction.aspects/issues need to be considered in setting a layout.
	Step-V:Time-10 Minutes Facilitator will seek participants understanding of the following as part of evaluation process through question-answer: 1. What is a layout and what is its necessity? 2. How and where to create a layout? 3. What are its advantages, disadvantages, imperatives, etc.? 4. Which disaster risk reduction issues are relevant for consideration while making a layout? . Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; s/he then will wrap up the session with vote of thanks

Facilitator's Guide

(House Layout)

Layout/Periphery of a house refers to its location/situational aspect and its construction formula; layout in the appropriate point allows adequate light and wind ventilation in the house, makes for homestead beauty, minimizes storm wind pressure and ensures slender possibility of plinth collapse.

Following issues warrant due consideration to determine house layout:

Area: Total area of a house should measure 18'x10'-6"+6' in view of SPHERE Standard and normal house-building calculation/practice in rural Bangladesh. Such area is determined to consider and accommodate living space, provision of guest and family conference point, storage of household materials, personal privacy of women, girls, elderly persons and persons with disability, etc.

Location: South-faced main door of the house ensures adequate light and wind. Because of geographic location; Bangladesh features wind flow from south-western corner for better part of the year. On the other hand, wind flows here from north-east side during winter. As a result, sufficient light and wind are available in the house with comparatively cool atmosphere during summer, and conversely, house is quite warm and humid during winter.

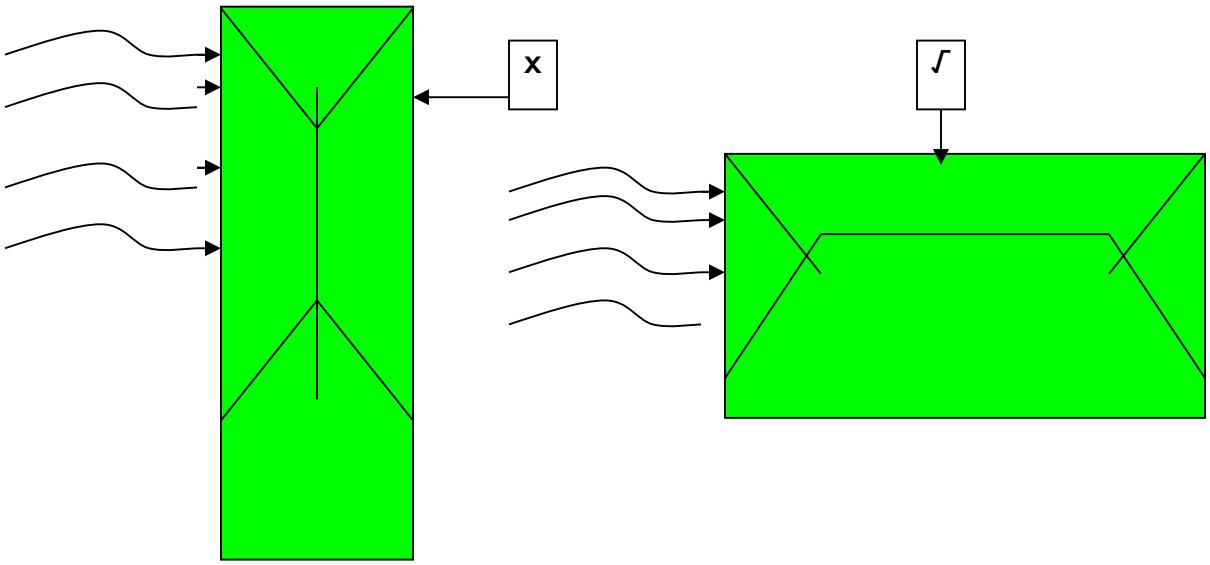
It is better and advisable to provide for kitchen, water source and latrine as close to the house as practicable for the safety of women, girls and children as well as for convenience of elderly and persons with disability. Water source and latrine ought to be at least 30 feet apart; they can however be closely situated where sanitary latrine is provided with septic tank.

There should be provision of proper sewerage and drainage for the sake of healthy and pollution-free atmosphere around the homestead.

Neighbours should be consulted to learn their advantages and disadvantages while marking out the precinct of the house; this makes way for peaceful coexistence in the area.

Layout Cost: An amount of **BDT500.00** – **BDT1, 000.00**

Pictures depicting issues/matters relevant to Layout drawing



Proposed and Discouraged House Design

Picture 1: Where the breadth of the house faces the direction of gusty wind, air pressure minimizes and house blown-off possibility reduces

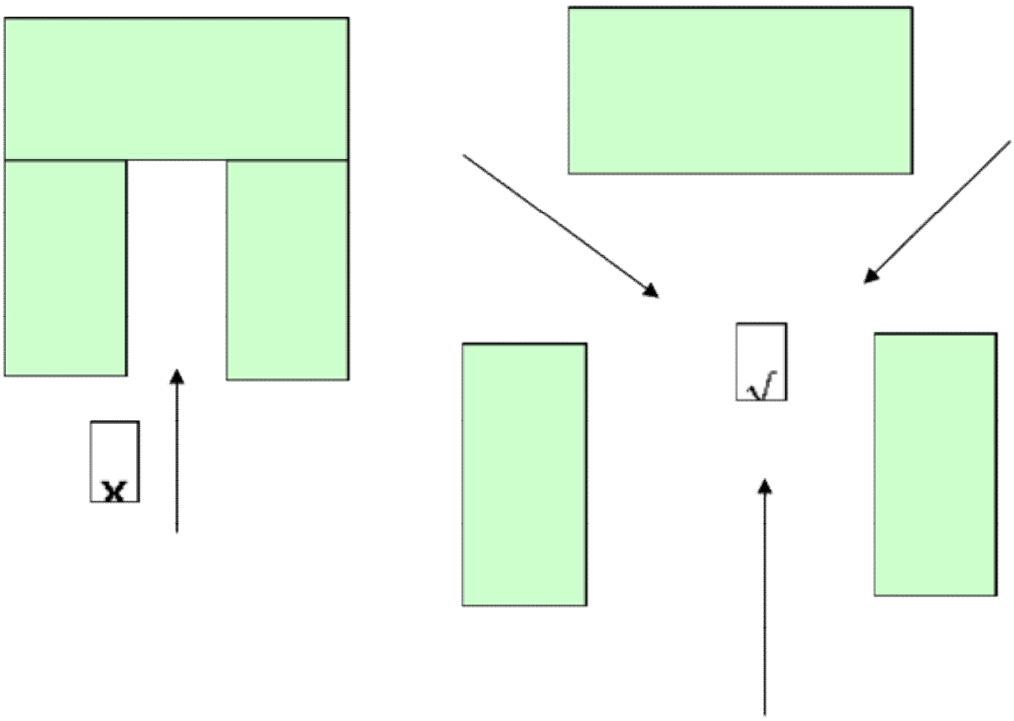
Pictures 2 and 3: House construction adjacent to pond or canal or river is very risky

Pictures depicting issues/matters relevant to Layout drawing

Pictures 4: Construction of house has to be done considering River current/movemnt

Picture 5: House plinth/floor should be formed at least 450 meters or 1'-6" feet above the flood/storm surge water level to reduce risk	

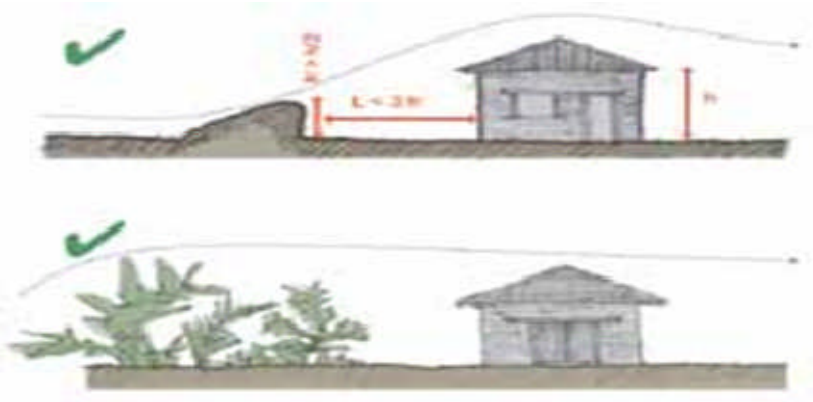
Pictures depicting issues/matters relevant to Layout drawing



Picture 6: Forming house layout with provision of sufficient wind passage as above allows adequate wind and light inside and reduces air pressure

Pictures 7 & 8: Provision of latrine at 30 feet distance from the house in north or western side keeps the house stink free

Pictures depicting issues/matters relevant to Layout drawing



Picture 9 Tree plantation at suitable distance in the vicinity of the house makes for minimum storm-wind slash leading to lesser risk of house collapse; tree plantation is imperative to contain/withstand wind slash (Sketch Credit:IFRC)

Picture 10: House construction in safe distance discounts the risk of house collapse through tree-falling

Picture 11: House construction in unsafe/insecure distance involves the risk of house collapse through tree-falling

Session II

Subject: Foundation of the House
(Second Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define various types of Foundation, Foundation of low-cost disaster-friendly house as well as its importance. 2. To refer to necessary building materials and describe construction strategy in relation to Foundation of low-cost disaster-resilient house. 3. To reflect on the relevant aspects/issues of disaster risk reduction while engaging in house Foundation and inform others accordingly. 4. To assist others in working out the Foundation of low-cost disaster-resilient house according to noted design.
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Foundation Model, Multi Media (if available), Module, Board, Poster/Brown Paper, Marker, Leaflet, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session, at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-30 Minutes 1. Facilitator will discuss about definition of foundation, various types of foundation, foundation of low-cost disaster-resilient house and its importance by way of picture/model display and/or drawing on board or brown paper in view of the handout. 2. S/he will narrate about foundation worked out through brick, RC stone, RC pillar, soil/clay, etc., and its implementation He will later display model or picture of each foundation and hold discussion through question-answer; locality focus foundation and its implementation process should however gain priority in the discussion.
	Step-III:Time-20 Minutes Facilitator will refer to the benefit of foundation and explain the drawback of a weak foundation; he will then discuss about maintenance of foundation, construction deadline and cost. S/he would ensure that the discussion is not one-way and that the participants can raise questions.
	Step-IV:Time-10 Minutes Facilitator will apprise the participants which matters/issues need to be considered to reduce disaster risk during foundation work; s/he will utilize handout and might display picture or model to that end.

Session Conduction Process (Contd.)	**Step-V:Time-00:10 Minutes** Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. What is foundation? 2. What materials are required during foundation work? 3. What are the benefits and drawbacks of foundation? 4. What issues deserve consideration to reduce disaster risk during foundation work? Facilitator might be required to reiterate point(s)/issues as s/he deems appropriate for the sake of participants clarity; s/he then will wrap up the session with vote of thanks.

Tip for the Facilitator

The Facilitator is required to consult various books, reports, updates, etc., relating to this topic apart from the module in order to gain clear concept of the subject matter; s/he might also try to collect any other relevant case-study to bolster his perception.

Facilitator's Guide

(House Foundation)

Foundation

Foundation is the base on which a house is developed/erected. Overall weight of the house is transformed into underground through foundation. Foundation has to be on hard compact soil as per appropriate design/sketch/drawing. Otherwise, weight of the house might cause its subsidence underground leading to crack/rupture/breakage in wall, pillar or any portion of the housing gears. Foundation is thus considered as very essential part of the house.

Characteristic Detail

1. Breadth of a house is generally found to be large or small in consideration of the weight or load borne by wall and pillar.

2. Foundation depth of a house generally differs in view of its height, disaster perspective and local custom/practice.

3. Possibility of house tremor, leaning and blown-out due to storm can be overcome if pillar is dug at least 1'-6" feet deep inside the hard soil and T-shaped plate is set below the pillar.

4. Foundation is to be interwoven with required number of anchors, otherwise wind might blow away wooden gears.

Construction Strategy

1. Foundation base ought to be at hard compact soil layers.

2. There should not be any foundation work at artificially filled-in soil layers. Even if foundation base is worked out at artificially filled-in soil layers, it has to be strong and hard as per appropriate foundation design.

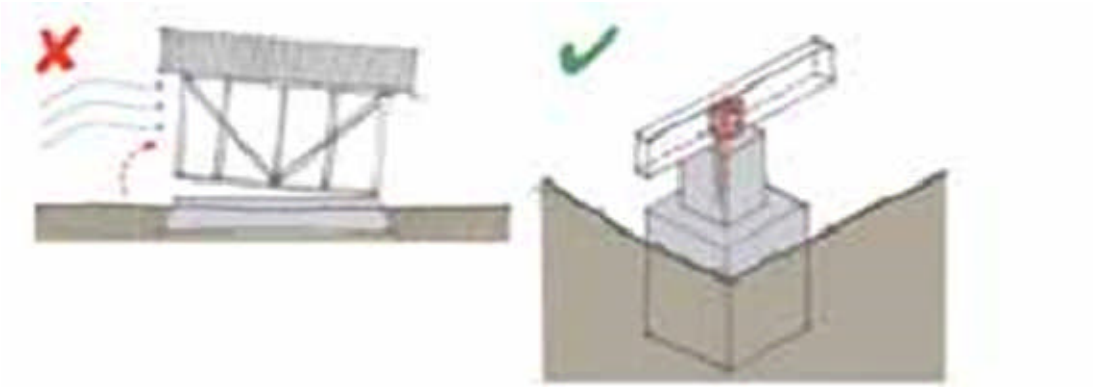
3. The pillar has to be inserted at least 1'-0.6" feet deep inside the hard soil (through a Paddle as used by Bangladesh Rural Electrification Board, if required); the hole is to be compacted with a blending of hard soil, sand, brick-chips, stone-chips, etc., to prevent pillar's movement.

4. Bottom portion of brick-wall and pillar foundation hole needs to be hardened through excessive pressure through hammering .

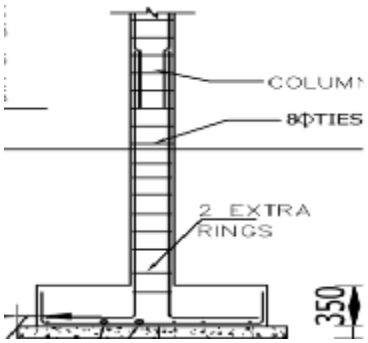
5. Foundation place has to be filled-in hard and hammered with compacted soil or sand after pillar setting.

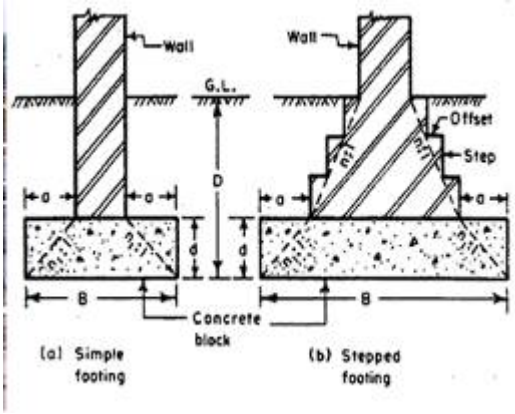
6. Provision of appropriate measure like drainage has to be there to prevent water accumulation at foundation base.

Pictures depicting issues/matters relevant to Foundation Work

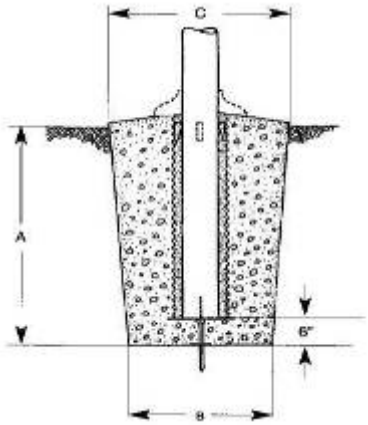


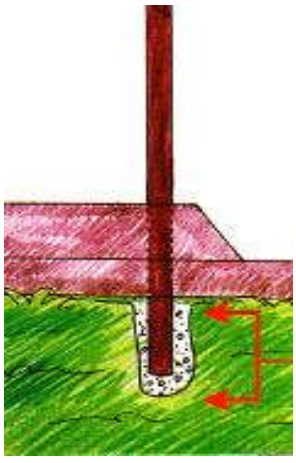
Picture 12: Required number of Anchors should accompany the foundation (Sketch Credit:IFRC)





Picture 13: RC Column Foundation	Picture 14: Brick-work Foundation





Picture 15: RC Pillar Foundation	Picture 16: Wooden Pillar Foundation

Comparative Analysis of Advantages and Disdvantages of various types of Foundation

Foundation Detail	Advantages	Disadvantages
Bamboo/Wooden Pillar Foundation	Comparatively less costly	Less sustainable/Less strong
	Easily available in the locality	Scarcity of mature bamboo
	Skilled Artisan is not required	Vulnerable to insects or wood-worm
	Easily repairable	
RC Pillar Foundation	Sustainable/strong	Comparatively costly
	Do not bend easily	Skilled Mason is not always available
	Comparatively more disaster resistant	Comparatively hard to repair

Advantages

House will not bend and wall will remain crack-free as long as hard soil layers will form its foundation wth required depth and width according to stipulated design.

Disadvantages

1. Cost is comparatively higher.

2. Skilled labourers are required.

3. Accumulation of water at foundation base might cause it to subside downwards triggering wall-slide and leading to life damage and property loss.

Maintenance

Corroded portion/wasahed away soil of the foundation base resulting in hole should regularly be filled-in with quality soil, hard-pressed with hammer and plastered

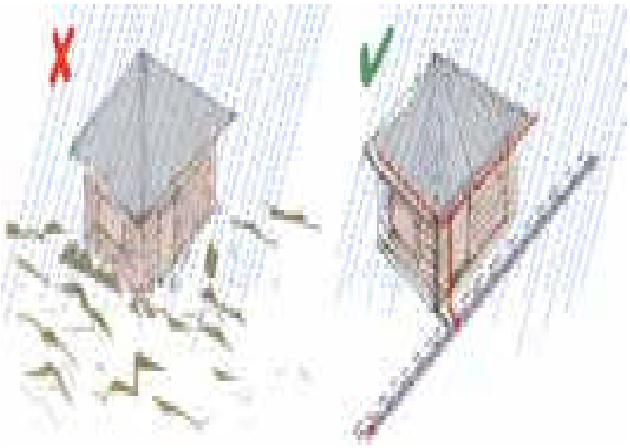
Estimated Cost of Foundation (18' feet x10'-6" feet plus 6' feet width balcony)
(as per Guide Book)

Bamboo/Wooden Pillar Foundation

Sl. #	Work Item	Amount in BDT
1	Earth cutting, hole boring and soil pressing involving 02 Labourers	800.00
2	Mixturing brickchips and sand for strong foundation	1,200.00
	Grand Total	**2,000.00**

RC Pillar/Stone Pillar Foundation

Sl. #	Work Item	Amount in BDT
1	Earth cutting, hole boring and soil pressing involving 02 Labourers	630.00
2	Stone collection, stone-soil mixturing	3,360.00
	GrandTotal	**3,990.00**



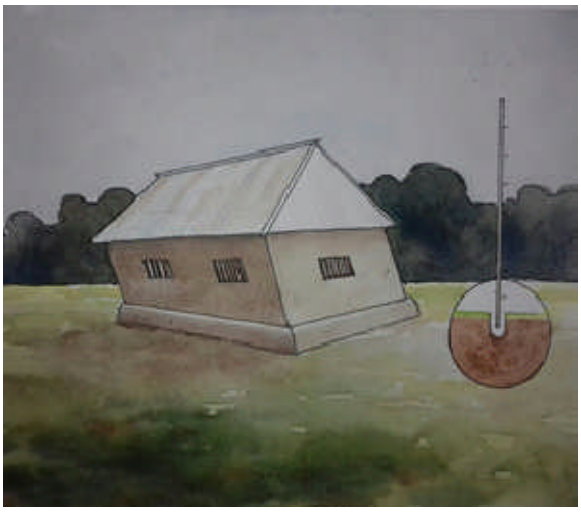
Pictures 17 & 18 Accumulation of water at foundation base causes soil erosion / corrotion weakening the house; provision of appropriate measure like drainage has to be there to prevent water accumulation at foundation base (Sketch Credit:IFRC)

Pictures 19 and 20: Foundation base ought to be within strong soil layers; subsiding base triggers crack in the wall

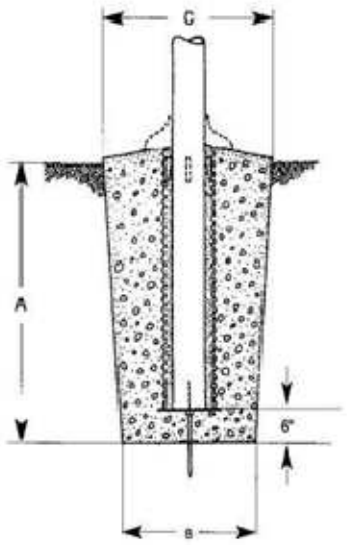
Pictures 21: Picture of a sound Foundation base

Pictures depicting issues/matters relevant to Foundation Work

Picture 22: Pillar insertion/digging at least at a depth of 1’-6” feet in strong soil forestalls any chance of house leaning



Picture 23: Pillar insertion/digging in strong soil less than a depth of 1’-6” feet retains the possibility of house leaning



Picture 24: If wall layers are joined at 0-6” feet height over the courtyard, water cannot creep into the wall	Picture 25: Bangladesh Rural Electrification Board uses such Paddle

The pillar has to be inserted/dug at least 1’-6” feet deep inside the hard compact soil (through a Paddle as used by Bangladesh Rural Electrification Board, if required); the hole is to be compacted with a blending of hard soil, sand, brick-chips, stone-chips, etc.; eventually, pillar will have no scope of movement.

Session III

Subject: Plinth of the House
(Third Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Plinth of the house construction and learn its importance . 2. To learn various types of house Pinth, their respective features, advantages and disadvantages. 3. To come across the strategy and process of constructing disaster-resilient Pinth. 4. To describe disaster risk reduction matters/issues while developing a Pinth and apprise others accordingly.
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Foundation Picture/Model, Multi Media (if available), Module, Board, Poster/Brown Paper, Marker, Leaflet, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session, at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-30 Minutes 1. Facilitator will discuss about definition of plinth, various types of plinth, plinth of low-cost disaster-resilient house and its importance by way of picture/model display and/or drawing on board or brown paper in view of the handout. 2. S/he will display model or picture of each type of plinth and hold discussion on implementation of various types of plinth through question-answer; house plinth common in the locality and its implementation process should however gain priority in the discussion.
	Step-III:Time-20 Minutes Facilitator will refer to the benefit of plinth and explain the drawback of a weak plinth; s/he will then discuss about maintenance of plinth, construction deadline and cost. S/he would ensure that the discussion is not one-way and that the participants can raise questions
	Step-IV:Time-10 Minutes Facilitator will apprise the participants which matters/issues need to be considered in respect of disaster risk reduction during plinth work; s/he will utilize handout and might display picture or model to that end.

Session Conduction Process (Contd.)	**Step-V: Time-00:10 Minutes** Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. What materials are required to develop a plinth? 2. How to well maintain a plinth? 3. What issues matter in respect of disaster risk reduction while constructing a plinth? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Plinth)

Plinth

Plinth is a very important and indispensable part of a house. The space between the courtyard level and floor of the house is plinth. Plinth might take various designs or forms depending on house type, disaster perspective in the area, local custom/practice etc. For example, plinth formed by mixture of soil and other elements, brick-built plinth and stone-based plinth, etc. People in some area again are accustomed to bamboo or wooden platform as plinth as part of their custom/ptactice.

Characteristic Detail

1. Plinth type is determined by local custom, culture, practice and local availability of materias.

2. Length and breadth of the plinth measures at least 0-6" feet larger than that of the house for the sake of sustainability.

3. Plinth height is determined by house location, hazard aspect and local custom/practice; in additiuon, the height of the plinth is kept at least 1' feet more than the normal flood or water-logging level to stave off or reduce inundation water.

4. Mould of plinth soil is mixed with one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, stiff grass, paddy husk, etc., depending on availability, in order to ensure strong and crack-resistant plinth.

5. Plinth is made sloppy with provision of steps to make it strong. Plinth height determines its slope and steps; generally 2/3 rungs.

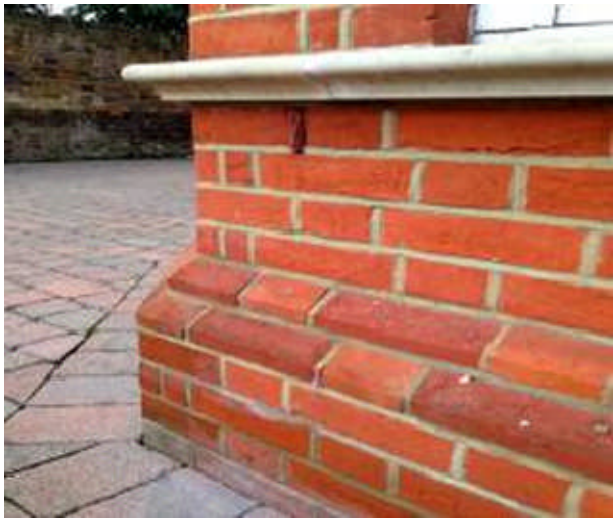
Comparative Cost of Plinth developed by various Ingredients

Plinth Detail	Total Budget (BDT)
Earthen Plinth with Balcony (18' long x 16'-6" wide: 545 Cft.)	4,500.00
Plinth with Ferro Cement (with earth filling)	15,000.00
Brick work Plinth (with earth filling)	25,000.00

Pictures depicting various types of Plinth

Picture 26: Earthen Plinth

Picture 27: Stone-based Plinth



Picture 28: Brick-built Plinth

Picture 29: Localized Platform House

Earthen Plinth

Construction Strategy

1. Mould of plinth soil is well mixed with one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, stif grass, paddy husk, etc., depending on availability, in order to ensure strong and crack-resistant plinth.

2. Earthen mould has to be prepared along with ring-wall encircling the house and floor space to be filled-in before finalizing the plinth. Earth filling upto 0-6" feet layer along with hammering/hard-pressing of the soil is an effective deterrent to floor subsidence and crack

3. Extended portion of the roof has to be such that rain-water pouring down the roof lands 0.0'-0.6" feet afar from the plinth, thereby preventimg any damage to the plinth out of rain-water.

Time-frame

06 (six) Labourers would need to engage for 03 (three) days to complete earth-filling of 1'-6" feet height plinth and floor of a house measutring 18' feet in length x 10' feet width along with a balcony measuring 6' feet.

Advantages

1. Plinth strengthens overall structure of the house.

2. Required soil/clay forming the plinth along with mixing materials is locally available.

3. Landlord can equally engage in plinth work.

4. Application of any of (i) dry binya grass (a special type of grass), (ii) damaged paddy, (iii) dry straw, (iv) stiff grass, (v) paddy husk, etc., to plinth soil results in minimum/minor crack in the plinth, reduced soil erosion as well as prevents damp/humidity and adds to sustainability.

5. Plinth structured with requisite steps is comparatively stronger than normal plinth.

6. Plinth with attached steps is well-neigh immune to damage from rain-water; only the lower step might however be affected if and when circumstances turn unfavourable. Besides, rungs/steps can be repaired without much hassles at minimum cost when damage occurs; plus, overall management cost and labour charge are meagre.

Disadvantages

1. Green grass, dry straw, etc., tend to suck out earthen plinth, crack might result in the process; white ant might also be damaging.

2. Plinth is vulnerable to rat-hole.

Maintenance

1. Plinth has to be smeared/treated with cow-dung at least once a month; frequency might vary according to locality.

2. Washed away and/or eroded and/or hole-affected areas of the plinth must be filled-in forthwith, to be followed by hammer-pressing and plastering/polishing.

3. Vegetables, crop items, dry fish, etc., should not be stored / kept on the plinth floor to avoid any direct contact with the earth.

4. Rat menace must be addressed in no time.

Pictures depicting issues/matters relevant to Plinth Work

Picture 30: One Step is provided where the height between the ground and plinth level measures one feet

Picture 31: One-and-a-half feet height from ground to plinth level warrants two Steps

Picture 32: Three Steps are in place where height from ground to plinth level is more than one-and-a-half feet

Picture 33: One inch slope is provided in case of one feet height

Pictures depicting issues/matters relevant to Plinth Work

Pictures 34 and 35: If and when one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, stiff grass, paddy husk, etc., is smeared/polished with the mould of plinth soil, depending on availability, plinth gets strong and crack-resistant

Picture 36: Earthen mould has to be prepared along with ring-wall encircling the house and floor space has to be filled-in with appropriate soil/clay prior to finalizing the plinth. Earth filling upto 0-6" feet layer along with hammer-pressing of the soil is an effective deterrent to floor subsidence and crack.	Picture 37: Additional portion of the roof has to be so extended as rain-water pouring down the roof lands 0-6" feet afar from the plinth, thereby preventimg any damage to the plinth out of rain-water.

Pictures depicting issues/matters relevant to Plinth Work

Picture 38: Use of green grass, dry straw, etc., tends to suck out earthen plinth, crack might result in the process; white ant might also be damaging.	Picture 39: Earthen plinth is very much vulnerable to rat hole

Picture 40: Rain-water mark; plinth topsoil has been washed away. ,	Picture 41: Specimen of a cracked plinth.

Picture 42: Roof should have 0-6” feet extension beyond the house fence or wall	Picture 43: Plinth has to be smeared/ plastered at least once a month; frequency might vary according to locality

Brick Work Plinth

Brick-built plinths are common in water-logged, flood vulnerable and *haor* (wetland ecosystem) area of Bangladesh, because earthen plinths are unsafe and weak in the face of water ingress. Besides, brick-built plinths are sustainable and protective against thieft, apart from adding to social status.

Characteristic Detail

1. Five-inch bricks are utilized to prepare nine-inch high brick-built plinth

2. Ten-inch bricks should better be utilized for preparing nine-inch to two-feet high plinth; a mixture of ten-inch and five-inch bricks may however be an alternative option in the light of the design in order to reduce cost.

3. Ten-inch and fifteen-inch bricks may be used in case of 2'-3' feet high plinth as per design.

4. In respect of plinth in haor/wetland and saline water area, entire outer part of the brick-built plinth should be well plastered/covered with net-cement finishing; which should go six inch underground

Picture 44: Defective design results in crack in the plinth.	Picture 45: There can be brick-built plinth for a part of plinth area (vulnerable to rain-water sprinkles), avoiding the whole plinth area, so as to minimize cost.

Pictures.46 & 47: Mud-mix ingredients can be applied to the plinth as a measure to minimize cost; but in that case, there has to be a pointing through mixing cement and sand.

Construction Strategy

1. Brick-work will commence with soaking first grade bricks. First grade bricks are not susceptible to breakage/damage if dropprd down from chaste-height position after setting them crosswise (lengthwise and diagonally) one above another. They will be of copper colour and must not be rough and uneven in shape.

2. Brick-chips will have to be suitably blended with cement and sand according to required proportion, later to be watered; and this mixture must be put into use within one hour.

3. Thickness of mixed ingredients in the joint must not be less than 12mm and more than 20mm.

4. Masonry joint must be in the middle point of each brick; however joint would have to be one-fourth in respect of ten-inch brick-work.

5. Masonry must be completed per appropriate plumb-line .

6. Sand required in masonry has to be well strained so as to sieve out any unwanted and damaging particle.

7. Joints have to be well cleaned after work.

8. Saline water and saltish sand must not be applied in mason-work and plaster.

9. Curing will follow for at least 07 (seven) days within 24 (twenty-four) hours of masonry and plastering work.

Time-frame:

06 (six) labourers will have to engage for four days to complete brick plinth and earth filling of the floor of a house measuring 18’ feet length x 10’ feet breadth x 8’ feet height.

Estimated Cost to construct a Brick Plinth of 8’ feet height along with a balcony:

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
First grade Brick	1325 Ea	12.00	15,900.00
Sand	46 Cft.	30.00	1,380.00
Cement	05 Bags	500.00	2,500.00
Labourers Wage	01 Mason and 02 Associates	Lump Sum	2,220.00
		Grand Total	2**2,000.00**

One might decide ro have brick-built plinth only in the plinth side facing substantial rain-water sprinkles, avoiding the whole plinth area, so as to minimize cost.

Session IV

Subject: Pillar of the House
(Fourth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about different types of Pillar of the house and their importance. 2. To explain about construction strategy of different types of Pillar and their costing. 3. To refer to advantages, disadvantages and maintenance of different types of Pillar. 4. To learn about low-cost disaster-resilient Pllars and inform others in this respect. 5. To explain the disaster risk reduction aspects/issues to be considered while making Pillars
Time	85 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Board, Poster Paper, Chalk/Marker, Picture, Model, Handout, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-20 Minutes Facilitator will discuss on the following through lecture, question-answer, display of picture, model, etc. in the light of the handout: Types of pillar, its necessity and importance.
	Step-III:Time-25 Minutes 1. Facilitator will discuss about the construction strategy and cost of various types of pillar by way of picture/model display, drawing on board and reading from the handout 2. S/he will display model or picture of each type of pillar and hold discussion on advantages, disadvantages and maintanence thereof S/he would ensure that the discussion is not one-way and that the participants can raise questions
	Step-IV:Time-15 Minutes Facilitator will resort to the handout to apprise the participants which matters/issues need to be considered to reduce disaster risk during pillar work

Session Conduction Process (Contd,)	**Step-V:Time-15 Minutes** Facilitator will seek participants knowledge/perception on the following as part of evaluation process through question-answer: 1. What is a plillar meant for? What is its necessity and importance? 2. What about pillar's formation mode and cost? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

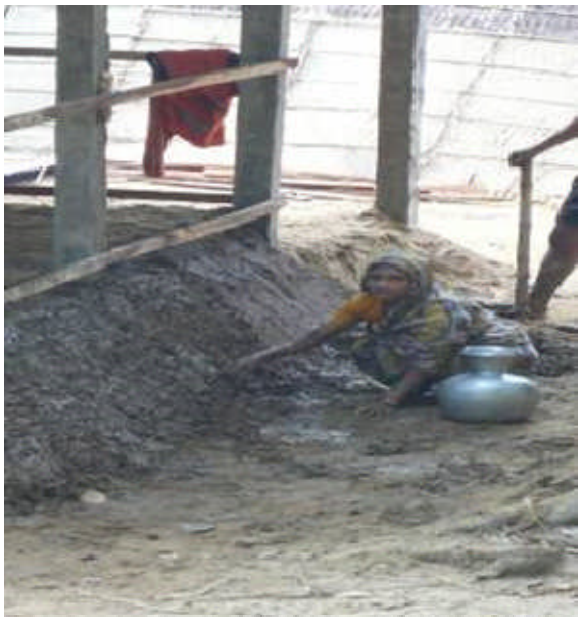
Pillar

House roof in rural Bangladesh is usually set over wooden pillar or bamboo pillar or RC pillar or brick wall. Weight of the roof is thus transferred onto the earth; a linkage between house and earth is established and effectiveness of the house structure is thereby ensured.

Scarcity of mature wood, insect/worm attack, pillar decay/decomposition at the base, excessive cost, etc., substitutes RC pillar on the large scale for the wooden pillar

Picture 48: Termite affected wooden pillar

Picture 49: Wooden pillar affected by Insect through earth/soil contact



Picture 50: Use of RC pillar in rural area is on the rise

RC Pillar

Characteristic Detail

- Length of the pillar of the main house is generally 10’ to 12’ feet and section – 5” inch x 5” inch or 4” inch x 4” inch
- Length of the pillar of the balcony is generally 9’ to 10’ feet and section – 4” inch x 4” inch
- 04 (four) vertical 10mm dia MS Rod; 8mm dia Stirrup or Ring every 06 (six) inches (according to sketch/picture)

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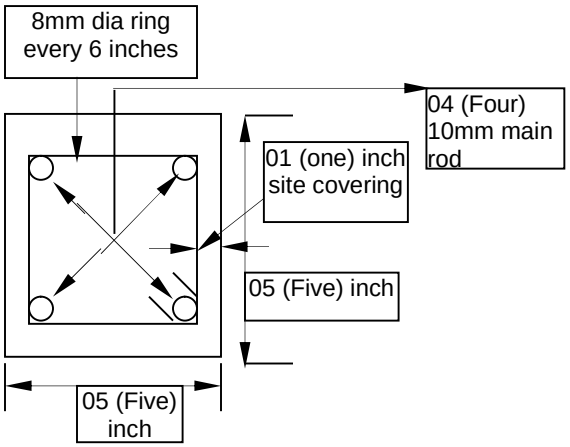
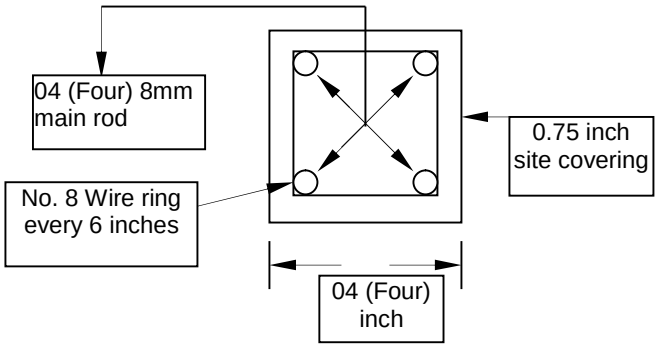
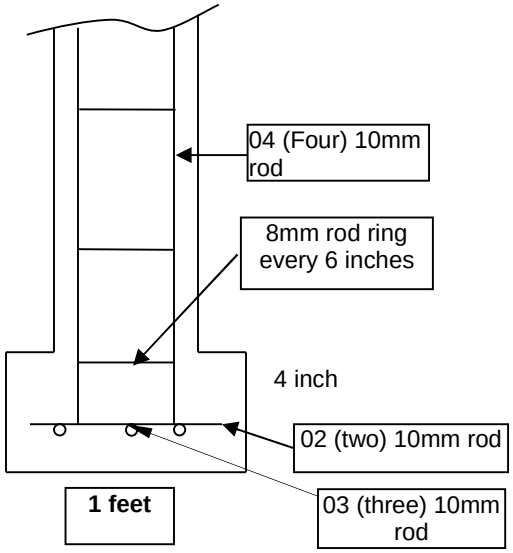


Graphics. 51: One RC Pillar section



Graphics. 52: One 04 (Four) inch RC Pillar section



Graphics. 53: One vertical column section

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Construction Strategy

1. Cement, sand and stone-or-brick chips are to be blended at 1:2:4 ratio; to be mixed later with concrete applying proper quantity of water, so that the blended product does not get thin.
2. Half inch down-grade brick-chips are to be applied.
3. Sand and brick/stone chips are to be properly filtered in a strainer.
4. Thick sand has to be properly filtered before use in casting so as to sieve out any iota of stone, dust or rubbish inside; as because, fine sand must be free from dust/rubbish.
5. Brick and stone chips must be well washed prior to blending.
6. The pillar has to be dug at least 1'-6" feet inside the foundation/base (through a Spud/Paddle utilizing rural electricity, if necessary). The hole has later to be compacted with hard clay, sand, brick-chips, stone-chips, etc. so as to avoid any movement of the pillar.
7. Pillar has to be dug vertically through plumb-line, so that it does not bend.
8. Pillar has to be perforated so as to properly bind the fence and/or set the doors/windows and corner bracing in good order
9. Roof frame has to be strongly tied with RC pillar through additional rod, nut, bolt, etc., atop to prevent the roof from being blown away by wind/storm surge.
10. Pillar mould/forma should well be soaked in water or coated by heated mobil before casting
11. Pillar mould/forma should be removed 16 hours after casting
12. Pillar's corner must not be sharp
13. Sweet water should be utilized for pillar's casting and curing, invariably not saline water; and the water ought to be free from straw,grass or leaves
14. Curing should span over a period of 14 days
15. Proper covering of the structure of rod(s) is to be ensured before casting/at the time of shuttering

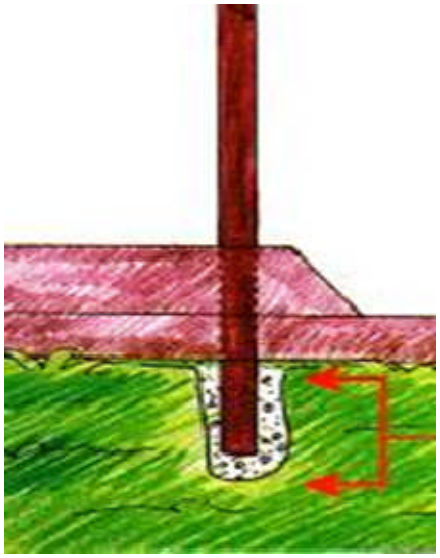
Time-frame and Cost

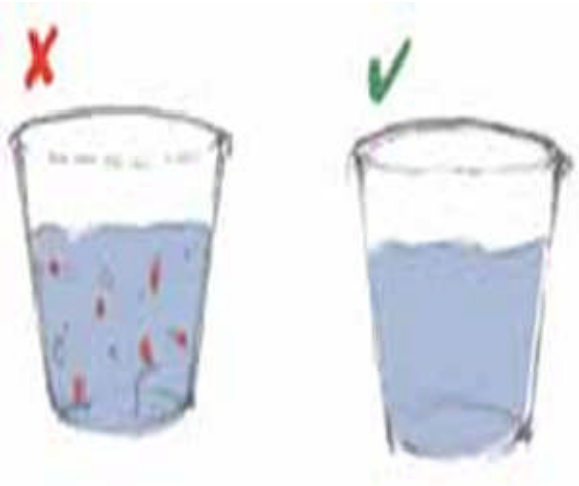
One mason along with an associate can very well complete casting of 04 to 05 pillars a day along with fastening rod and shuttering

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
11' long Pillar of 4"x4"	6 Ea	800.00	4,800.00
9' long Pillar	3 Ea	650.00	1,950.00
11' long Bamboo	10 Ea	200.00	2,000.00
		Grand Total	**8,750.00**

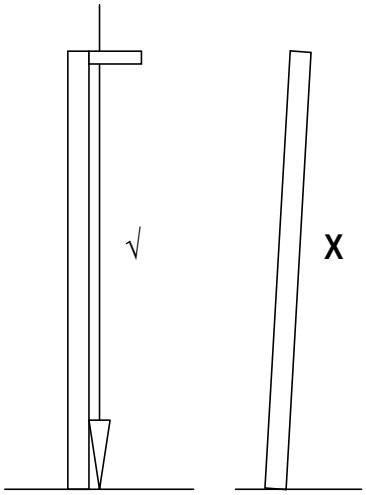
Note: Term "*Ea*" or "*Each*" is a standard unit for any countable item from materials management perspective

Pictures depicting issues/matters relevant to preparing RC Pillar





Picture 54: The pillar has to be dug at least 1'-6" feet inside the foundation/base. The hole has later to be compacted with hard clay, sand, brick-chips, stone-chips, etc. so as to forestall any movement of the pillar.	Picture 55: Drinkable water is to be used while casting pillar. (Sketck Credit-IFRC)



Picture 56: Pillar has to be dug vertically through plumb-line, so that it does not bend or tend to bend	Picture 57: Pillar has to be perforated so as to properly bind the fence and/or set the doors/windows and corner bracing in good order

Pictures depicting issues/matters relevant to preparing RC Pillar

Pictures. 58 & 59: Roof frame has to be strongly tied with RC pillar top using additional rod, nut, bolt, etc., to prevent the roof from being blown away by wind/storm surge. .

Picture 60: Cement, sand and stone-or-brick chips are to be blended at 1:2:4 ratio to make out a strong and hard RC Pillar

Advantages

1. RC Pilar is stronger than, and can withstand/absorb more wind pressure in comparison to, bamboo/wooden pillar
2. It can last 15-20 years, if properly prepared
3. Its repairing is hardly required
4. It is less costly compared to mature wood
5. Requisite construction materials are locally available

Disdvantages

1. RC Pillar might develop crack and succumb to salinity, if its coveriing is not appropriate
2. Its transportation might be problematic because of its weight
3. It cannot be elongated in future
4. Its fitting and fixing with house roof, bracing and fence are difficult in comparison to wooden pillar

Maintenance

Marine paint should be applied to the base of RC Pillar so as to prevent damage from saline water

Pictures depicting issues/matters relevant to preparing RC Pillar

Picture 61: RC pillar might develop crack and succumb to salinity, if its coveriing is not appropriate	Picture 62: RC pillar keeps immune to damage from saline water, if marine paint is applied to its base	Picture 63: Its weight might prove problematic to its transportation

Bamboo Pillar
(*Borak*-local variety)

Product of Bangladesh, availability of local materials and incurring minimum cost dictate maximum use of mature bamboo pillar, *Borak* bamboo, (local variety) to construct earthen house in average villages of Bangladesh.

Characteristic Detail

1. House pillar is generally 09' to 12' feet in length with 3" to 4" inch dia
2. At least 3-year old mature bamboo is used to overcome worm-attack; yellow colour at the bamboo joints confirms its 3-year maturity
3. 1'-6" feet bamboo of borak/baijjya/vailka variety (local terrm) is used as house pillar we are talkling about

Construction Strategy

1. At least 3-year old straight mature bamboo is utilized as house pillar
2. Bamboo for pillar should be gathered from bamboo garden during Bangla months of *Falgun* and *Choitra* (corresponding to mid-February to mid-April) of the year; mature bamboo ought to be cut off from the garden before appearance of new leaves
3. Pillar has to be dug at least 1'-0.6" feet deep inside the indigenous original earth/clay
4. The hole has to be well compacted following insertion of the pillar
5. The pillar has to be dug vertically to prevent any tendendency to lean down
6. There has to be a groove atop the pillar so as to well fasten the pyre; groove/sheath is to be carved slightly above the pillar-joint
7. Bamboo for pillar has to be dried up for 07 (seven) days following collection from the source. It has to be drenched under pond/canal/river water at least for 03 (three) weeks and later dried again for seven days before ultimate use. Pillars dried for seven-days are long-lasting and immune to worm-attack; This process is termed 'seasoning' or locally branded as pannet/painally
8. Pillar can be alternatively wet underground in dug-out water, in case there is no pond, canal or river
9. Bottom part of the pillar underground plus six inches above the ground should be smeared/mixed with tar, thereby making it immune to worm-attack
10. Similarly, it can also be kept immune to worm-attack if bottom part of the pillar underground plus six inches above the ground is made brown through baking/burning in fire
11. Pillar base should be a little below than its joint
12. Bamboo pillar lasts 10-15 years, if it is set over wood-wedge
13. Nails should be penetrated into bamboo pillar with the help of awl; otherwise if handled/executed by hammer, bamboo might develop crack/fissure

Picture 64: Specimen of seasoning	Picture 65: Specimen of tar mixture

Picture 66: Specimen of wood-wedge	Picture 67: Mature bamboo

Cost

Estimated cost of a pillar measuring 9' to 12' feet long and 3" to 4" inch dia would be BDT 200.00; 16 pillars to be set every three feet to cover a house measuring 18' feet long and 10' feet wide, plus 04 pillars for balcony would thus cost **BDT4,000.00**.(Taka Four Thousand only)

Advantages

1. Bamboo pillar is available almost everwhere in Bangladesh
2. It incurs very minimal cost
3. House owner, too, can prepare bamboo pillar all by himself
4. Mature and seasoned bamboo lasts 4-5 years
5. If set on the wood-wedge, bamboo pillar lasts 10-15 years
6. Better part of the pillar can be recycled

Disadvantages

1. Pillar gets insect-affected without mature bamboo or if bamboo is not seasoned
2. Part of the pillar inside the soil succumbs to easy decay/decomposition

Maintenance

Maintenance is not required as such; pillar's minimum contact with soil and water should however be ensured

Wooden Pillar

Product of Bangladesh, local materials and its availability, capability of incurring requisite cost, custom/practice, etc., dictate maximum use of mature bamboo pillar to construct earthen house in the country; wooden pillars are however comparatively largely used in hilly area.

Characteristic Detail

Pillar of the house generally measures 9' to 12' feet high and 04" inch x 04" inch dia; dia is generally 03" inch x 03" inch in case of round-shaped pillar. Length and dia of the pillar in the balcony is smaller in comparison to the height of the house itself.

Construction Strategy

1. Mature wood is required for pillar
2. The Pillar has to be dug at least 1'-6" feet inside the foundation/base (through a Spud/Paddle utilizing rural electricity, if necessary). The hole has later to be compacted with hard clay, sand, brick-chips, stone-chips, etc. so as to avoid any movement of the pillar.
3. The pillar has to be dug vertically by way of a plumb-line to prevent any tendendency to lean down
4. Grooves have to be carved out atop the pillar so as to fasten the roof tight
5. Pillar has to be drenched/submerged under water at least for 03 (three) weeks and later dried for 07 (seven) days before use; seven-day dried pillars are long-lasting and immune to worm-attack;
6. Wooden pillar lasts 20-25 years, if it is set over wood-wedge
7. Pillar is remains immune to worm-attack if lowest part of the pillar underground and six inches above the ground is made brown through baking/burning in fire

Cost

16 woden pillars would be placed every three feet to cover a house measuring 18' feet long and 09' feet wide, plus 04 pillars would be there for balcony; a pillar measuring 09'-12' feet long with 02"-03" inch dia will cost BDT=1,000.00. Total cost would thus come to **BDT=20,000.00** (Taka Tweny thousand) only.

Advantages

1. Mature and seasoned wooden pillar would last at least 10-12 years
2. Wooden pillar lasts 20-25 years, if it is set over wood-wedge
3. Despite its decay in the bottom, better part of the pillar can still be recycled
4. Expansion of the house and pillar repair is by and large easy

Disadvantages

1. Cost is comparatively high

2. In case the pillar is not made of mature wood and not properly seasoned, worm-attack is a sure possibility
3. Pillar part dugged underground succumbs to decay/decomposition fast

Maintenance
Maintenance is not required as such; pillar's minimum contact with soil and water should however be ensured

Comparative Cost Analysis of Bamboo Pillar, Wooden Pilllar and Bamboo-cum-RC Pillar

Bamboo Pllllar

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
Bamboo Pillar for the master house (11'x3")	16 Ea	200.00	3,200.00
Bamboo Pillar for the balcony (11'x3")	04 Ea	200.00	800.00
		Grand Total	4,000.00

Wooden Pillar

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
Wooden Pillar for the master house (11'x4"x4")	16 Ea	1,000.00	16,000.00
Wooden Pillar for the balcony (9'x4"x4")	04 Ea	1,000.00	4,000.00
		Grand Total	20,000.00

Bamboo-cum-RC Pillar

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
RC Pillar for the master house (12'x4"x4")	8 Ea	1,700.00	13,600.00
RC Pillar for the balcony (10'x4"x4")	04 Ea	1,400.00	5,600.00
Bamboo pillar for the master house (11'x3")	10 Ea	200.00	2,000.00
		Grand Total	21,200.00

Session V

Subject: House Fencing
(Fifth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about different types of Fence 2. To distinguish and explain between CI Sheet Fencing and Bamboo Fencing as well as their respective advantages and disadvantage . 3. To describe the technology to be applied and materials to be utilized for sustainable but low-cost CI Sheet Fencing and Bamboo Fencing 4. To explain the disaster risk reduction aspects/issues to be considered in respect of CI Sheet Fencing and Bamboo Fencing and inform others accordingly 5. To reflect on the strategy to care and maintain CI Sheet Fencing and Bamboo Fencing
Time	70 Minutes
Methodology	Lecture, Discussion, Group Discussion, Question-Answer, , Picture/Sample/Model display
Materials	Board, Poster Paper, Multi-Media (if available), Fence Specimen/Model, Marker, Pen & Writing Book, Handout, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about the fence, its necessity and importance 2. S/he will reflect on the various types of fence common in different places with the help of multi-media, model/picture display, etc. 3. S/he will undertake discussion through question-answer about fence making strategy common in a particular area 4. S/he will involve the participants in discussion on respective advantages and disadvantages of CI Sheet fencing and Bamboo fencing .
	Step-III:Time-20 Minutes 1. Facilitator will undertake discussion through question-answer on the construction strategy of earthen wall prevalent in the area 2. Following the update on the problems around fencing, he will share with the participants the reasons behind the identified problems and ways to solution thereof 3. S/he will later reflect on, and share with them about, disaster-friendly technology and strategy available from the Caritas-implememted pilot project with the help of multi-media, picture/model display, etc

Session Conduction Process (Contd.)	**Step-IV:Time-10 Minutes** Facilitator will apprise the participants in the light of handout or with the display of picture/model which matters/issues need to be considered to reduce disaster risk around fencing
	Step-V:Time-10 Minutes Facilitator will seek participants view/opinion on the following as part of evaluation process through question-answer: 1. What is a disaster-friendly house? What are the advantages and disadvantages of the fence meant for such a house? 2. What kinds of sustainable technology are applicable to preparing fence in the area? 3. What materials/ingredients are required to ensure more sustainable fence? 4. What matters/issues are relevant for consideration around disaster risk reduction while preparing a fence? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Fencing)

Wall/Fence

Wall/Fence covers the house from all sides as well as the area in-between the floor and the ceiling. Wall or fence of a house ensures safety and privacy of life and property of the insiders as its prime agenda. We come across various types of wall and fence based on custom/practice in the area and materials/ingredients available there; like, bamboo fence, CI sheet fence, CI sheet-cum-bamboo fence, wooden fence, fence from jute stick, fence made out of *Ekor* (a local variety of sun-grass), fence formed through straw (a country ingredient), fence prepared from *Taty* (a country ingredient), earthen wall, brick wall, etc. A house is again subdivided in the form of rooms through partition wall or fencing partition.

Bamboo Fence

Characteristic Detail

1. A mature Mulee bamboo (a local variety) needs to be divided into two parts/splits for the purpose of fence
2. Back part of the mature mulee bamboo is utilized for outside fence of the house and front part is meant for partition fence. This bamboo can also be used in preparing the front side fence of the house to provide for balcony
3. Fence is to be modeled on the measurement of the house
4. Fence formed of mature bamboo is tied by string/thin nylon rope/thin plastic rope at one foot interlude with provision of at least 1" inch width knot on both the sides
5. There can be two or three parts of a house fence: tin can form the bottom part of the fence from floor to lower tip of the window measuring 2'-6" feet in height, the middle part comprising the area from the bottom part of the window to the top of the door might be constituted by bamboo and the remaining part towards the top can formulated by thin split bamboo part.

Construction Strategy

1. Seasoned bamboo has to be utilized. For that purpose, bamboo has to be submerged in water for 21 (twenty-one) days and dried later for 07 (seven) days in the sun prior to use.
2. Three-pronged/two-pronged splits of mature bamboo have to be tight-fastened according to the size of the house
3. Coarse bamboo mat fence is to be prepared and suitably tight-fastened according to the size of the house (in the light of the picture)
4. Tin fencing at the bottom is to be set inward of the house and bamboo fencing at the upper part is to be placed outward
5. Corners of the fence are to be suitably tied and bamboo laths or old tyre have to be placed at corner-joints; this will ensure effectiveness of fencing knots and people will feel safe against any odds

6. Rows of bricks/long wood/long bamboo is to be used at the bottom of the lower part of the fence; wooden door might be used, if necessary
7. Fence is to be tied to each pillar of the house using wire/nylon rope/plastic rope
8. Tin fencing of 22-24mm thickness is to be used at the lower part of the fence
9. 1" thick x 2" width wooden Batten has to be used vertically for tin fencing
10. Batten has to be nailed every two feet. In case of fence, it has to be nailed below tin's wave area; tin's forepart has to be aligned with Batten
11. Tar/paint should be applied to the lower portion of the CI sheet fence; colour tin can alternatively be used. This will protect the lower portion of the fence from early damage owing to rain water and contact with soil

Pictures depicting issues/matters relevant to preparing Fence

Picture 68: Use of seasoned bamboo is a valid deterrent against worm-attack. For that purpose, bamboo has to be submerged in water for 21 days and dried later for 07 days in the sun prior to use	Picture 69: Three-pronged/two-pronged fence made out of mature bamboo splits

Pictures depicting issues/matters relevant to preparing Fence

Picture 70: Coarse bamboo mat fence to be prepared to make for tight-fastened fence

Picture 71: CI sheet fencing at the bottom is to be set inward of the house and bamboo fencing at the upper part is to be placed outward, so as to baulk rain-water inside

Pictures 72 & 73: Corners of the fence are to be suitably tied and bamboo laths or old tyres have to be placed at corner-joints; this will ensure effectiveness of fencing knots and people will feel safe against any odds

Pictures depicting issues/matters relevant to preparing Fence

Picture 74: Placement of rows of bricks/long wood/long bamboo at the bottom of the lower part of the fence will by and large keep the CI sheet rust-free	Picture 75: Application of tar at the lower portion of the CI sheet fence will protect the lower portion of the fence from early damage owing to rain water and contact with soil

Partition

Partition separates two rooms of the house by wall or fence. Partition provides for secured privacy. It is indispensable for female and male as well as for children's education.

Partition results from one or more of the following: bamboo fence, CI sheet fence, jute stick fence, ekore fence, straw fence, tati fence, brick wall. wooden fence, earthen wall, etc.

Comparative Cost Analysis of Fence prepared with Bamboo-cum-CI Sheet, CI Sheet and Brick-cum-CI Sheet

House Fence from Bamboo-cum-CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Bamboo Mat	168 Cft.	20.00	3,360.00
CI Sheet–0.23 mm/8 Ft.	13 Ea	400.00	5,200.00
Wood (1.50"x1.00")	1.50	1,000.00	1,500.00
Artisan Wages	1	1,000.00	1,000.00
		Grand Total	**11,06**

House Fence from CI sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
CI Sheet–0.23mm/8 Ft.	26 Ea	400.00	10,400.00
Wood (1.50”x1.00”)	3	1,000.00	3,000.00
Artisan Wages	1	1,000.00	1,000.00
		Grand Total	**14,40**

House Fence from Brick-cum-CI sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Brick, etc., volume	140 Cft.	100.00	14,000.00
CI Sheet–0.23 mm/8 Ft.	13 Ea	400.00	5,200.00
Wood (1.50”x1.00”)	1.50	1,000.00	1,500.00
Masonry Wages	1	1,000.00	1,000.00
		Grand Total	**21,70**

Session VI

Subject: Doors and Windows
(Sixth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about the importance of Doors and Windows 2. To narrate about site selection and preparation mode of Doors and Windows . 3. To describe about advantages, disadvantages and cost involving Doors and Windows 4. To explain the disaster risk reduction aspects/issues to be considered in respect of Doors and Windows and inform others accordingly 5. To describe how to maintain Doors and Windows
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing and Picture/Sample/Model display of Doors and Windows
Materials	Marker, Masking Tape, Pin, Brown Paper, Specimen/Picture of Doors and Windows, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about various types of doors and windows and their necessity 2. S/He will reflect on construction strategy of doors and windows as well as their importance and cost.
	Step-III:Time-15 Minutes Facilitator will reflect on disaster risk reduction strategy in respect of doors and windows and explain with the help of picture
	Step-IV:Time-10 Minutes Facilitator will seek participants view/opinion on the following as part of evaluation process through question-answer: 1. What are the importance, advantages and disadvantages of the doors and windows? 2. What needs to be done to reduce disaster risk while engaging with doors and windows? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then he will wrap up the session with vote of thanks

Door

Door is required for the house inmates to enter in the house, facilitate flow of adequate wind and light inside as well as ensure security and privacy of all. Local custom/practice and availability of materials/ingredients determine the type, nature and shape of the door to be worked out. Door consists of a door-frame and a door-shutter. Wooden door is common in average rural area of Bangladesh; Steel doors are being used now-a-days. Each house should have at least two doors.

Window

Window is indispensable to facilitate flow of adequate wind and light inside. Grill and/or sticks are set in the window to refrain anybody from entering inside and prevent any theft; window-shutters are used to ensure privacy and shield against untimely air and sunlight as well as rain water. Local custom/practice and availability of materials/ingredients determine the type, nature and shape of the window. Wooden window is however common in average rural area. It is advisable to have at least two windows in a room to facilitate adequate and regular flow of air and light in the house.

Picture 76: One window needs to be placed opposite to another so as to facilitate adequate wind-flow

Characteristic Detail

1. Generally, one door is set in the front of the house and another in the rear or at the side; again, a connecting door is sometime in place for the adjacent room.
2. Door height is generally 6'-7' feet and its breadth varies between 2'-0.6" to 3' feet.
3. Cross-section of the door-frame assumes various measurement: 2"x 2.50" inch, 2"x 3" inch and 2.50"x3" inch.

4. Thickness of the door-shutter is generally 1”x1.5” inch.
5. ‘Z’ batten or panel door is used.
6. 3”-5” inch size hinges and 4”-6” inch size hook/shackles/ring are set in the door for its opening and closure
7. One- or two-part door and window are used as per custom/practice in the area; people are accustomed to four-part window, too.
8. Window height is generally 3’-4’ feet and breadth 2’.06”-4’ feet or more; window is set 2’-6”-3’ feet above the plinth level
9. Cross-section of window-frame assumes various sizes: 2”x1.5” inch in case of bamboo fence and 2”x2.5” inch or 2.5”x3” inch in case of earthen wall. Thickness of window-shutter is generally 1”-1.50” inch
10. 3” inch size hinges and 4” inch size hook are used in the window. In addition, shackles/ring/wooden fastener/cramp is also used
11. Variety of wood is used for door & window depending on local availability. It must however be *sari kath* (in local term), implying quality wood possesing better kernel/substance

Construction Strategy

1. Seasoned timber of mature tree has to be used for door and window as per local custom/practice
2. Doors and windows made by seasoned timber last almost five times more
3. Doors and windows are treated with enamel paint for beautification and sustainability as well as to counter insect-attack and damage from water. Anointing with brownish oil at minimum cost adds to sustainability, too
4. Shutters should be set inside the house
5. One window needs to be placed opposite to another so as to facilitate adequate wind-flow
6. Additionally, windows should be placed in due consideration of the convenience of the neighbours/families living nearby

Time-frame and Cost

Five days (*four days as per the Guide Book*) would be required to make out and set one door and two windows (*two doors and four windows as per the Guide Book*) in a house measuring 18’ feet long and 10’ feet wide; total cost would come to **BDT15,000** (Taka Fifteen thousand) only: BDT7,000.00 for doors and BDT8,000.00 for windows. (*costing not mentioined in the soft copy*)

10 days are required to make out one door and two windows through plain Sheet (*not referred to in the hard copy*)

Advantages

1. Adequate light and wind are available in the house and healthy environment prevails

2. Security of life and property as well as dwellers privacy are ensured

3. Closure of both door-shutters and window-shutters in the winter ensures little cold

4. Doors and windows prevent water surge inside the house during rains and storm

5. Doors and windows made by plain sheet are sustainable and long lasting (*not referred to in the hard copy*)

Disadvantages

1. Doors and windows might be vulnerable to wood-louse attack

2. Expansion and contraction of door-shutters and window-shutters during winter and summer might affect smooth opening and closure thereof

3. Wooden doors and windows are less sustainable (*not referred to in the hard copy*)

4. Doors and windows made by plain sheet are comparatively more costly (*not referred to in the hard copy*)

Maintenance

1. Time to time application of kerosene or turpentine oil to door and window frames and shutters might prevent wood-louse attack

2. Prompt repair of any damaged part of the window is advisable

3. Doors and windows made by plain sheet should be painted time to time to make them long lasting (*not referred to in the hard copy*),

Comparative Cost Analysis of House Doors and Windows prepared with various constituting ingredients

Door and Window made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50' *Mehagony wood, thickness of door shutter 1", door-frame 3"x2.50"	01 Ea	3,000.00	3,000.00
Window with Grill 3'x2.50' *Mehagony wood, thickness of window-shutter 0.75", window-frame 2"x2"	02 Ea	1,500.00	3,000.00
		Grand Total	**6,000.00**

Door and Window made of CI Sheet-cum-Wooden Frame

Item Detail	Quantity	Unit Price(BDT)	Total Amount(BDT)
Door 2.50'x6.50', Tin door-shutter and wooden door-frame	01 Ea	1,650.00	1,650.00
Window 3'x2.50', CI Sheet window-shutter and wooden window-frame	02 Ea	800.00	1,600.00
		Grand Total	**3,250.00**

Door and Window made of Plain Sheet (*not referred to in the hard copy***)**

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door door-shutter and door-frame	01 Ea	5,000.00	5,000.00
Window door-shutter and door-frame	02 Ea	3,000.00	6,000.00
		Grand Total	**11,000.00**

*Renowned tree fetching good quality timber

Door and Window made of Steel

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50' MS Sheet thickness of door-shutter 22 Gauge, door-frame 1.50"x1.50" with MS Angle 3mm	01 Ea	5,000.00	5,000.00
Window with Grill 3'x2.50' MS Sheet thickness of window-shuttre 22 Gauge, window-frame 0.75"x0.75", thickness of MS Angle 2mm	02 Ea	2,000.00	4,000.00
		Grand Total	**9,000.00**

Session VII

Subject: House Truss and Shed
(Seventh Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about house Truss and Shed and their preparing strategy 2. To narrate in sequence about the type and measurement of wood to prepare Truss and Shed . 3. To learn and describe about wood, cost, sustainability and maintenance of easily and locally available wood 4. To explain the disaster risk reduction aspects/issues to be kept in mind while developing Truss and Shed and inform others accordingly
Time	70 Minutes
Methodology	Lecture, Discussion, Question-Answer, Group Discussion and Picture/Sample/Model display
Materials	Board, Multi-media, Handout, Poster Paper, Marker, Pen-Writing Pad, Cork Sheet, Wood-Bits, Nails, Hammer, Specimen/Model of Shed
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about house truss and shed, their necessity and importance 2. S/he will reflect on different types of truss and shed common in various areas through multi-media or picture or drawing on the board 3. S/he will initiate participatory discussion on the utility of truss and shed 4. S/he will then gradually engage in discussion on various houses we live in and their importance by way of picture display in multi-media; discussion will also cover the measurement of the shed of a strong and disaster-friendly house (for example, bracing/wall plate/top tie) 5. Lastly, discussion will concentrate on wood measurement concering different parts of a disaster-friendly house, estimated cost of various measurements of wood as well as wood treatment and maintenance
Session Conduction Process (Contd.)	**Step-III:Time-20 Minutes** 1. Facilitator will resort to question-answer to discuss on the construction strategy of truss and shed as prevailing in the area 2. After knowing the problems around the truss and shed, s/he will share the reasons behind such problems and way to solution thereof 3. Later, s/he will share the disaster-friendly technology available from Caritas-implemented pilot project by way of multi-media/picture/model
	Step-IV: Time-10 Minutes S/he will reflect on disaster risk reduction strategy in respect of truss

	and shed and share the same with the participants in the light of the handout and with the help of picture/model
	Step-V: Time-10 Minutes Facilitator will seek participants view/opinion on the following as part of evaluation process through question-answer: 1. What are the importance of truss and shed in house construction? 2. Where are the rafter, bracing, runner, wall plate, etc., used in truss and shed formation and what would be their respective measurement? 3. Which sustainable technology is relevant to truss and shed common in the area? 4. What materials/ingredients are required to enhance the sustainability of truss and shed? 5. What measures need to be considered for disaster risk reduction while developing truss and shed? 6. What are the ways to maintain low-cost truss and shed as well as its frameork? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Truss and Shed)

Roof Truss/Shed

Some kind of sheet is placed on wall and/or pillars of a house to cover it; roof truss is the frame set on the wall/pillars for such covering. Covering is placed on the roof truss or shed. Roof Truss/Shed is very indispensable and important for the house. Roof Truss/Shed might be made of bamboo, wood, steel angle, etc., based on landlord's financial capacity, local disaster perspective, local custom/practice, etc.

Vital Parts of Roof Truss/Shed

Wall Plate

Wall plate is placed on the main wall or the pillar of the house. Wall Plate keeps the roof truss/shed complete with tie-beam, rafter, bracing, etc., in tact as well as transfers the weight of the roof truss onto the wall or pillar.

Construction Strategy

1. Wall Plate must be formed of mature wood or bamboo
2. Wall Plate size differs on account of the material/element used: 3"x2" inch for wood, 3" inch dia for bamboo, 1.5"x1.5"x0.125" inch for iron angle
3. There should not be any joint in case of wood within 10' feet; and grooved lap joint needs to be used where the length is more than 10' feet
4. Where RC pillar matters, wall plate is to be tied tight with an extended rod on its top; or wall plate is to be perforated and fitted tight with nut and bolt on it
5. In case of bamboo wall, wall plate has to be tied tight with the carved U-type groove atop the bamboo using GI wire or nylon rope
6. As to brick wall, perforated wall plate is to be placed atop the wall and tied tight through nut and bolt
7. Additional/visible part of wire, rod, angle and nut has to be painted with anti-corrosive colour so as to check rust
8. Wood and bamboo have to be seasoned before use to make it sustainable and long lasting
9. Brownish oil or Kerosine oil or burnt mobil is to be smeared/polished with wood and bamboo as a measure to control and avoid insect-attack
10. Anti-corrosive paint is to be used in respect of angle

Picture 77: Strategy to prevent house shed from being blown away by strong wind

Cross Beam/Tie Beam

Cross-beams and Tie-beams are used to hold in safety the roof truss/shed made of rafter and clamp/purlin for covering the house and also to transfer its weight onto the wall or pillar. They are also required to set the ceiling properly. In addition, cross-beam and tie-beam have a contributory role to retain the truss in its designated location as well as to forestall and offset any twist or movement in the face of wind. King post or Queen post is placed on the cross-beam and tie-beam.

Construction Strategy of Cross-beam/Tie-beam

1. Cross-beam and Tie-beam are sourced from wood, bamboo and angle
2. Mature wood or bamboo is indispensable for making cross-beam and tie-beam
3. Wood or bamboo has to be seasoned prior to use for the sake of longevity and sustainability
4. Their size varies in view of the breadth of the house. Upto the breadth of 11' feet, cross-beam and tie-beam will be of minimum 5"x2" inch size for wood, at least 3" dia for bamboo and at least 1.5"x1.5"x0.125" inch for iron angle

5. Where the breadth is between 11' feet and 13'feet, cross-beam and tie-beam will be minimum of 5"x3" inch size for wood, minimum 3" dia for bamboo and minimum 2"x2" inch for iron angle

6. Avoidance of joints in cross-beam and tie-beam is advisable, and lap joint is suggested in case of compulsion

7. Number of cross-beams and tie-beams is generally dependent on the total number of rafters

8. In respect of wood, twisted nails are required to set cross-beams and tie-beams with the wall plate, and twisted nails would have to be screw-driven into the wall plate and not beaten or thrashed. Resultantly, the tie will not be loosened or unfastened in the face of wind. Simple nails may be used in other points/places.

9. Brownish oil or Kerosene oil or burnt Mobil is to be smeared/polished with wood and bamboo as a measure to avoid insect-attack .

10. Anti-corrosive paint is to be used in respect of angle

Rafter

Rafter is set on the wall plate to place house covering and other parts on the latter. Roof truss/shed along with the clamp/purlin is built on the rafter. Avoidance of joints in making out rafter is indispensable.

Construction Strategy

1. Rafter must be formed of mature wood or bamboo

2. Rafter size varies in view of the breadth of the house. Upto the breadth of 11' feet, rafter will be of minimum 2"x2" inch size for wood, minimum 3" inch dia for bamboo and at least 1.5"x1.5"x0.125" inch for iron angle

3. Where the breadth is between 11' feet and 13' feet, rafter will be minimum of 2.5"x2.5" inch size for wood, minimum 2.75" inch dia for bamboo and minimum 2"x2"x0.1875 inch for iron angle

4. Where the house is within 11' feet breadth, top-tie has to be used to hold two rafters in safety and to contain excessive wind pressure. Size of the top-tie will have to be compatible to that of the clamp/purlin. Top tie has to be set at the confluence of two rafters and 1/3 (one-third) height distance of tie beam (above the meeting point of two rafters)

5. King Post is to be set if the breadth of the house exceeds 11' feet and Queen Post is to be set if the breadth of the house exceeds 13' feet; Size of the king post and queen post should be the same as rafter size.

6. Placement of rafter is dependent on its size: it is generally set every 2.5' feet

7. Wood rafter and bamboo rafter may be alternatively used as a measure to minimize cost

8. 04 (four) corner-rafters have to be in place in respect of four-sided roof truss/shed. Where the breadth of the house is 11' feet, two rafters each of the size 2.5"x2.5" inch minimum for wood and 1.5"x1.5"x0.1875 inch minimum for iron angle have to be fixed; and in case of the house having 11" to 13' feet breadth, two rafters each of the size 3"x3" inch minimum for wood and 2"x2"x0.1875" inch minimum for iron angle have to be fixed

9. Rafter has to be fixed with wooden and bamboo wall plate using twisted nail; and twisted nails would have to be screw-driven into the wall plate and not beaten or

thrashed; rafters have to be fastened at the same time with the wall plate through the hurricane strap. As a result, detachment of the both out of wind pressure will have scant possibility. Simple nails might be used in other points/locations

10. At least two nails have to be inserted in any joint; one-nail joint will be very weak
11. Wood corner rafter is better to be used for wood rafter
12. Where iron angle matters, rafter is to be fixed with wall plate through nut and bolt or welding
13. And in respect of bamboo, rafter is to be fixed with wall plate through wire, nylon rope, rope, etc.
14. Anti-corrosive paint is to be applied to the visible/additional parts of the wire, rod, angle, nut and bolt, etc., so as to combat rust
15. Seasoned timber and bamboo have to be used to make for sustainable and long-lasting rafter
16. Brownish oil or Kerosene oil or burnt Mobil is to be smeared/polished with wood and bamboo as a measure to avoid insect-attack
17. Anti-corrosive paint is to be applied in respect of angle

Clamp/Purlin

Clamp/Purlin is set on the rafter to place the roof truss/shed of the house. Wooden or Angle clamp/purlin is generally made use of.

Construction Strategy

1. Clamp/Purlin is to be sourced from mature wood
2. Wooden Clamp/Purlin is to be used for both wooden and bamboo rafter
3. Clamp/Purlin size for wood and angle will be respectively minimum of 2.5”x1” inch and 1.5”x1.5”x0.125” inch size
4. Size and number of clamps/purlins will depend on rafter’s length and distance
5. Seasoned timber has to be used to ensure sustainable and long-lasting clamp/purlin
6. Brownish oil or kerosine oil or burnt mobil is to be smeared/polished with wood as a measure to avoid insect-attack
7. Anti-corrosive paint is to be applied in respect of angle

Comparative Cost Analysis of developing House Truss/Shed

Wooden Truss/Shed

BDT16,000.00 (Taka Sixteen thousand) is estimated for completing a truss/shed for a house measuring 18' long x 10' feet wide plus 6' feet balcony involving labourers wages and procurement of requisite materials/ingredients like wood, nails, baton, etc.

Iron Angle Truss/Shed

BDT24,000.00 (Taka Twenty-four thousand) is estimated for completing a truss/shed for a house measuring 18' long x 10' feet wide plus 6' feet balcony involving labourers wages and procurement of requisite materials/ingredients like angle, etc.

Comparative Cost Analysis relevant to framing House Truss/Shed
(*as per Guide Book*; *not appearing in the Soft Copy*)

House Truss/Shed made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood *Mehogany, *Rain-tree, *Eucalyptus (size as per design)	18 Cft.	850.00	15,300.00
		Grand Total	**15,300.00**

House Truss/Shed made of MS Angle

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Ms Angle measuring (1.5"x1.5"x3 mm Dia)	275	65.00	17,875.00
		Grand Total	**17,875.00**

*Trees fetching quality timber

Session VIII

Subject: House Roof/Covering/Canopy
(Eighth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about House Roof/Covering and its importance 2. To narrate the technique and strategy of framing a House Roof/Covering 3. To reflect on the utility of living under a disaster-resilient House Roof/Covering 4. To describe clearly about the maintenance of a House Roof/Covering 5. To explain the disaster risk reduction aspects/issues to be considered in respect of preparing a House Roof/Covering and inform others accordingly
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Displaying the ingredients/materials concerning house roof/covering and Experience sharing
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Nails, Ingredients/Materials for preparing a house roof/covering
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will attempt at a definition of house roof/covering, reflect on its various types, its importance, display the ingredients/materials required to develop a house roof/covering as well as its cost 2. S/he will narrate the strategies of setting a house roof/covering and practically demonstrate these with the help of picture 3. Lastly, s/he will deal with the utility of the house roof/covering
	Step-III:Time-15 Minutes Facilitator will resort to practical demonstration or picture display to narrate what aspects/issues are relevant to disaster risk reduction while goiung for a a house roof/covering
	Step-IV:Time-10 Minutes Facilitator will seek participants idea/knowledge of the following as part of evaluation process through question-answer: 1. What is a house roof/covering, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction while developing a house roof/covering? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Roof)

House Roof/Covering

House Roof/Covering acts as a canopy over the house truss built on the wall or pillars. We find various kinds of house roof framed with different materials like dry straw, chhawn pata (local variety)/dry leaves, jute stick, bamboo splits, polythene, asbestos sheet, colour sheet, CI sheet, RC materials, etc. depending on: financial ability of the landlord, house type, local hazard perspective, local custom/practice, etc.

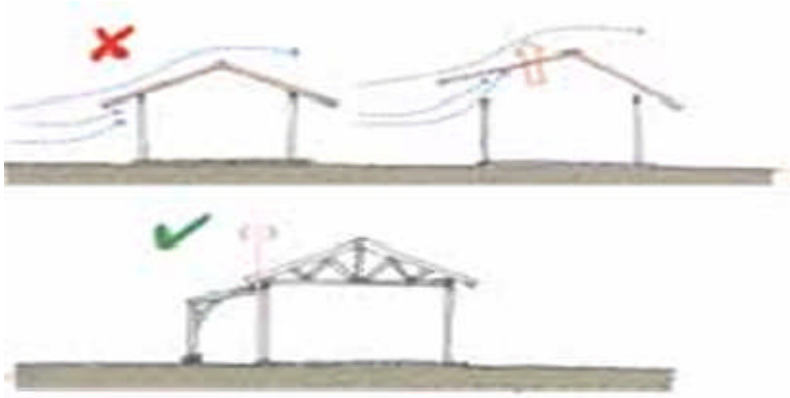
Construction Strategy

1. House Roof is formed with the materials like dry straw, *chawn pata* (country variety)/dry leaves, jute stick, bamboo splits, polythene, asbestos sheet, colour sheet, CI sheet, RC materials, etc., to act as a canopy covering the clamp/purlin of the house truss
2. ***House Roof formed with one or the other of dry straw, chawn pata/dry leaves, jute stick, bamboo splits***: dry straw, *chawn pata,* jute stick, bamboo splits, etc., have to be spread all over the clamp/purlin of the house truss and strongly tied with jute rope, nylon rope, plastic rope, bamboo cane, galvanized wire, etc.; later, there has to be another round of materials setting in the same way on the first line, sparing half or some part/area of the line (previous lining); full house truss/shed will thus be covered in stages with house roof.
3. ***House Roof formed with polythene***: polythene sheet has to be spread all over the house truss/shed (except clamp/purlin) and strongly tied with bamboo splits, jute rope, nylon rope, plastic rope, galvanized wire, etc., to cover the full house truss.
4. ***House Roof formed with colour sheet or GI sheet***: one line 1.5 wave lapping by colour sheet or CI sheet has to be completed over the clamp/purlin of the house truss and strongly tied with clamp/purlin using roofing screws or nails; later, at least 0-6" feet portion of upper part of the first line has to be filled-in, or otherwise lapped, and colour sheet or CI sheet is to be tied in the same way in the second round. Full house truss will thus be covered in stages with house roof. Upper meeting part at the four corners of the roof is to be linked / adjusted with ridging roofing screw to effect above.
5. Colour sheet or CI sheet is to be set properly with careful calculation/measurement at the four corners of the roof in case of four-side roof to complete house roof. The sheets have to be carefully handled while chopping, so that left-over part is not wasted away.
6. Anti-corrosive paint is to be applied to CI sheet to guard against any rust and to extend house roof longevity
7. Roofing screws have to be screw-driven, and not thrashed into, the Colour sheet or CI sheet in all areas including the cyclone and storm belt. Nut has to be used along with washer; dented nails might also be tried. Part of the nail stretched/extended below the wood has to be bent.
8. In addition to Colour sheet or CI sheet, there has to be at least 1.5 wave lapping and one horizontal lapping of minimum 0-6" feet over another lapping

9. Rafter wood has to be extended 2” inch below from the terminal portion of Colour sheet or CI sheet (rafter top to be slopped from the sheet)
10. Each CI sheet must contain 03 (three) roofing screws/horizontal nailing; there has to be at least three-line roofing screw/nailing for 9’ feet long sheet
11. House roof needs to be set at minimum 30-degree and maximum 40-degree angle in order to prevent the roof from being blown away in the face of severe wind
12. For the same reason, house roof should be four-sided rather than two-sided
13. House roof has to be strongly tied with the main house framework to avoid damage out of severe wind pressure
14. The less is the extended part of the house roof, possibility of wind-triggered damage is scant
15. All the constituting parts of the house roof have to be properly fixed / adjusted with the walls. Roof is to be strongly fixed with ring beam utilizing galvanized nut-bolt, screw, nails and other metal frame. House roof rafter has to be directly fixed with ring beam through hurryiane strap.
16. Two rafters at the top have to be fixed side by side using harrycane strap
17. CI sheet has to be strongly fixed using adequate number of galvanized roofing screws as well as dented iron as a measure of protection against wind
18. Balcony has to be separate from the main house, so that the latter is not damaged even if the balcony is blown away by severe wind
19. Joints in the wood have to be strong and impregnable. Wood frame has to be properly anchored within the foundation through nut and bolt, so that frame is not de-linked from the base.

Pictures depicting issues/matters relevant to House Roof

Picture 78: House roof should be four-sided rather than two-sided as a measure to prevent the roof from being blown away in the face of wind (Sketch Credit-IFRC)

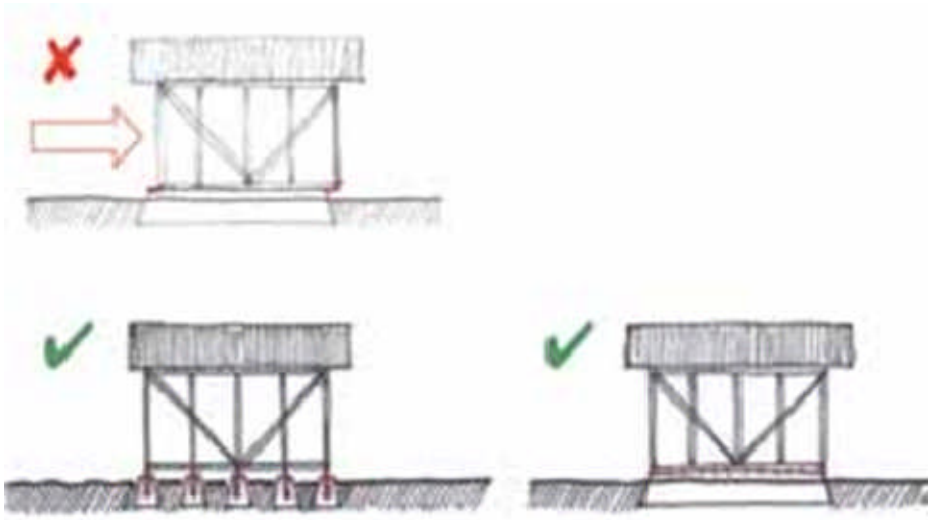


Picture 79: House roof has to be strongly tied with the main house framework to avoid damage whatsoever out of severe wind pressure (Sketch Credit-IFRC)

Picture 80: If the extended part of the house roof is between 8" inch to 1' feet, possibility of wind-triggered damage is scant (Sketch Credit-IFRC)

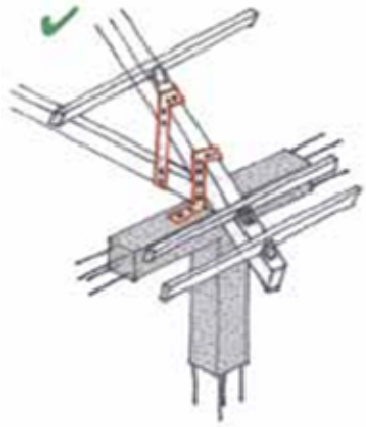
Pictures depicting issues/matters relevant to House Roof

Picture 81: House roof needs to be set at minimum 30-degree and maximum 40-degree angle as a measure to prevent the roof from being blown away in the face of wind (Sketch Credit-IFRC)

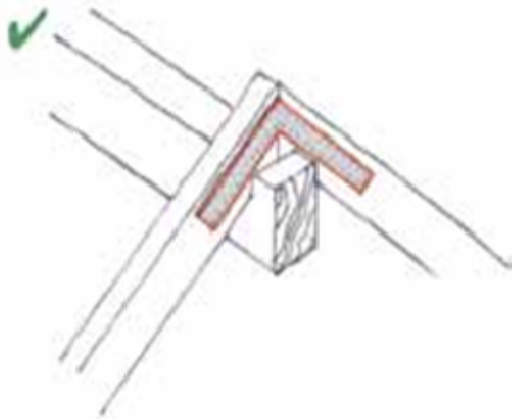


Picture 82: Joints in the wood have to be strong and impregnable; wood-frame has to be properly anchored within the foundation through nut and bolt, so that frame is not de-linked from the base. (Sketch Credit-IFRC)

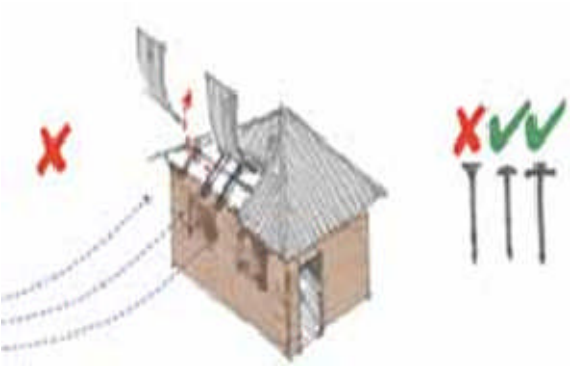
Pictures depicting issues/matters relevant to House Roof



Picture 83: House roof rafter has to be directly fixed with ring beam through harrycane strap (Sketch Credit-IFRC)



Picture 84: Two rafters at the top have to be fixed side by side using harrycane strap (Sketch Credit-IFRC)



Picture 85: CI sheet has to be strongly fixed using adequate number of galvanizing roofing screws and dented iron as a measure of protection against wind (Sketch Credit-IFRC)

Picture 86: Balcony has to be separate from the main house, so that the latter is not damaged even if the balcony is blown away out of wind (Sketch Credit-IFRC)

Estimated Cost of House Roof made of CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
CI Sheet for main House and Balcony 320mm/8'Feet	27 Ea	650.00	17,550.00
House Tua 260mm/6'Feet	10	200.00	2,000.00
Materials required for house roof fitting (screw, nail, rubber washer, nut-bolt, etc.)	Lump Sum		3,000.00
Fitting Charge including Truss	Lump Sum		7,000.00
		Grand Total	**29,550.00**

Session IX

Subject: House Bracing
(Ninth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about House Bracing and its importance 2. To narrate the technique and strategy of Bracing formation 3. To note about the advantages, disadvantages and cost of House Bracing 4. To explain which way of House Bracing will lead to disaster risk reduction in the area and inform others accordingly 5. To describe clearly about the maintenance of a House Bracing
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Displaying the ingredients/materials relevant to bracing and Experience sharing
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Nails, Wood, Hammer, Saw, Bracing Model
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-15 Minutes Facilitator will provide a definition of bracing, its importance and utility as well as explain various strategies of formulating a bracing with the help of its model
	Step-III:Time-20 Minutes Facilitator will resort to practical demonstration or picture display to narrate what aspects/issues are relevant to disaster risk reduction while preparing a bracing
	Step-IV:Time-10 Minutes Facilitator will seek participants perception of the following as part of evaluation process through question-answer: 1. What is a bracing, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction while formulating a bracing? Facilitator might be required to reiterate points/issues as s/he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Tip for the Facilitator

The Facilitator is required to consult various books, reports, updates, etc., relating to this topic apart from the module in order to gain clear concept of the subject matter; s/he might also try to collect any other relevant case-study to bolster his perception.

Facilitator's Guide

(House Bracing)

Cross Bracing

Cross Bracing is set with wood in a slanting direction between two pillars of the house. Cross bracing is effected by diagonally placing the wooden element across the two pillars dug in the two corners of the house according to the picture. Wood size in this respect would be 3"x2.5" inch. Thick and coarse rope or thin wire may also be used for cross bracing.

Resultant linkage/bonding between two pillars resulting from cross bracing prevents any leaning or movement of the house in the face of storm or severe wind. Bracing has to be vertical, diagonal and corner-wise to fetch a firm wood-frame. In the same way, there has to be plenty of vertical, diagonal and corner-wise bracings to ensure a firm house fencing.

Estimated Cost of Cross Bracing

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood 14' long and 5" dia	4 Ea	1,200.00	4,800.00
Bamboo 14' long and 3" dia	4 Ea	400.00	1,600.00
		Grand Total	**6,400.00**

Corner Bracing

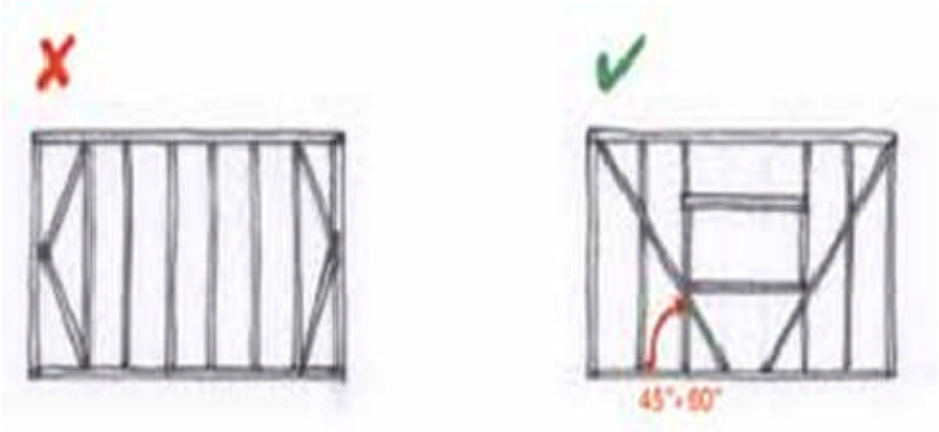
Corner Bracing is set along with wood in a slanting direction with the pillar and paiere on the upper part of the corner of the house. According to the picture, 3' feet long corner bracing is to be attached with the corner pillar in 45-degree tri-angle position. Wood size for the corner bracing would be 3"x2.5" inch. Corner bracing makes for bonding between the pillars and the house roof, obstructing any trend on the part of the house to lean back and/or move in the face of wind or storm surge.

Estimated Cost of forming Corner Bracing in the house

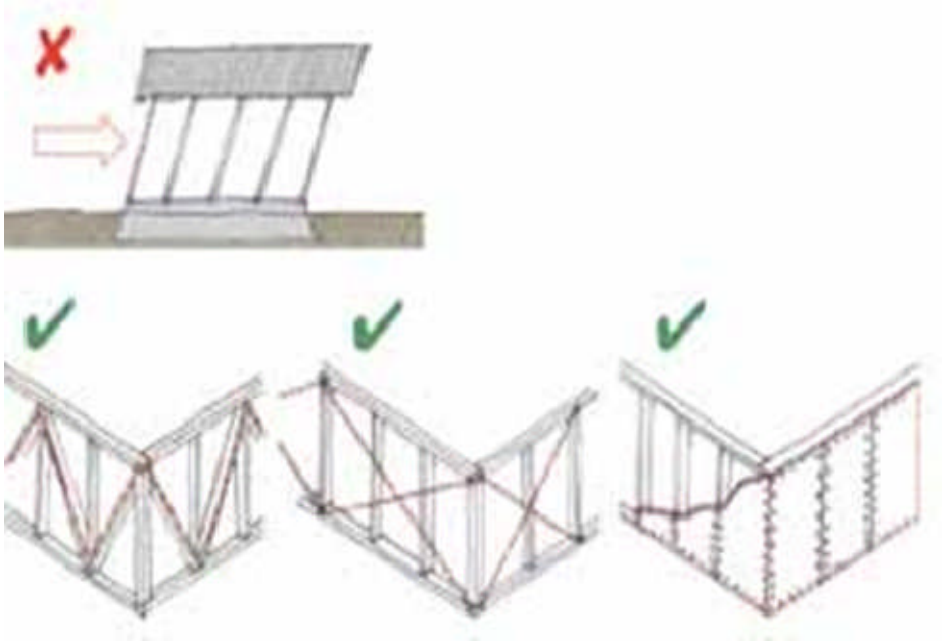
Corner Bracing made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood Mehogony 3'	1.2 Cft.	1,500.00	1,800.00
		Grand Total	**1,800.00**

Pictures depicting issues/matters relevant to House Bracing



Picture 87: There has to be properly set vertical, diagonal and corner-wise bracing to ensure a firm wood-frame (Sketch Credit-IFRC)



Picture 88: Plenty of vertical, diagonal and corner-wise bracings have to be set in the house fence in order to strengthen the fence (Sketch Credit-IFRC)

Pictures depicting issues/matters relevant to House Bracing

Pictures 89 & 90: Various types of Cross Bracing

Pictures depicting issues/matters relevant to House Bracing

Pictures 91 & 93: Various types of Corner Bracing

Session X

Subject: House Ceiling
(Tenth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Ceiling and describe its importance 2. To narrate the technique and strategy of formulating a Ceiling 3. To describe about the advantages, disadvantages and cost of Ceiling 4. To describe clearly about its maintenance 5. To explain the disaster risk reduction aspects/issues to be considered while developing a Ceiling and inform others accordingly
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Display of Ceiling, Demonstrating Ceiling Materials, Experience sharing, etc.
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Ceiling Model/Picture, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will define ceiling, reflect on its importance and discuss about different types of ceiling 2. S/he will refer to various materials required to make a ceiling, show its formation strategy and describe the utility of house covering/roof
	Step-III:Time-15 Minutes Facilitator will resort to practical demonstration with model display to narrate what aspects/issues are relevant to disaster risk reduction while developing a ceiling
	Step-IV:Time-10 Minutes Facilitator will seek participants view/opinion on the following as part of evaluation process through question-answer: 1. What is a ceiling, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction in respect of ceiling? Facilitator might be required to reiterate points/issues as s/he deems appropriate for the sake of participants clarity; then he will wrap up the session with vote of thanks

Facilitator's Guide

(House Ceiling)

Ceiling

Ceiling forms an important part of the house which safeguards and shields the inmates from sunshine heat and winter cold; light household items can also be stored / preserved thereon, especially during flood. It beautifies house setting, too. Family members can stay/live on the ceiling during flood, if it is hard, strong and high enough. Ceiling is generally made of bamboo splits and bamboo lath/clamp.

Picture 93: Ceiling made of Bamboo splits

Advantages and Disadvantages of a House Ceiling made of (i) Bamboo Splits and (ii) Wood

Ceiling Detail	Advantages	Disadvantages
Ceiling from Bamboo Splits	1. Skilled Artisan is not required 2. Controls house temperature (heat and cold) 3. Beautifies the house 4. Light valuable household items can be stored / preserved at the time of flood 5. Little time is required for its framing	1. Comparatively less strong or sustainable 2. Bulk/weighty items cannot be stored
Ceiling from Wood	1. Controls the room temperature (heat and cold) 2. Beautifies the house 3. Valuable household items can	1`. Comparatively costly 2. Skilled Artisan is required 3. Comparatively much time is required for its formation

	be stored and temporary accommodation ensured at the time of flood 4. Comparatively strong and long lasting	

Advantages

1. Ceiling keeps house cool during summer and hot during winter
2. Ceiling from bamboo splits involves comparatively less cost
3. Hardboard ceiling is suatainable and helps enhance house beauty
4. Ceiling from bamboo and wood is suatainable

Disadvantages

1. Ceiling/roof from bamboo splits turns out to be less sustainable
2. Ceiling/roof from immature bamboo is vulnerable to wood-louse damage

Comparative Cost Analysis to frame a House Ceiling

(i) Ceiling made of Bamboo Splits

BDT 10,000.00 (Taka Ten thousand) might be spent on account of developing the Ceiling of a house measuring 18' long x 10' wide

(ii) Ceiling made of Hard Board

BDT 16,000.00 (Taka Sixteen thousand) might be spent on account of developing the Ceiling of a house measuring 18' long x 10' wide

(iii) Ceiling made of Bamboo and Borga

BDT20,000.00 (Taka Twenty thousand) might be spent on account of developing the Ceiling of a house measuring 18' long x 10' wide

Estimated Budget* of a Disaster-resilient Low-cost House
House Size (Four-sided Roof): 18'-00"x10'-6"+6'-00"

STEPS	1ST MODEL	2ND MODEL	3RD MODEL
First: **Layout**	600.00	600.00	600.00
Second: **Base/Foundation**	700.00	700.00	1,100.00
Third: **Plinth**	4,500.00	15,000.00	25,000.00
Fourth: **Pillar**	2,500.00	8,750.00	8,750.00
Fifth: **Fence**	14,000.00	20,000.00	21,600.00
Sixth: **Doors & Windows**	3,250.00	6,000.00	11,000.00
Seventh: **Truss/Covering**	16,000.00	16,000.00	24,000.00
Eighth: **Roof/Canopy**	25,050.00	25,050.00	25,050.00
Ninth: **Corner Bracing**	1,500.00	1,500.00	1,500.00
Tenth: **Ceiling**	10,000.00	10,000.00	16,000.00
Total Amount (BDT)	**78,100.00**	**103,600.00**	**134,600.00**

(Concluded)